Engineering and Service Requirements of New Equitable Building—*Construction of Bus Structures and Regular Departments*

Electrical World

Volume 67, Number 3 McGraw Publishing Co., Inc. New York, January 15, 1916

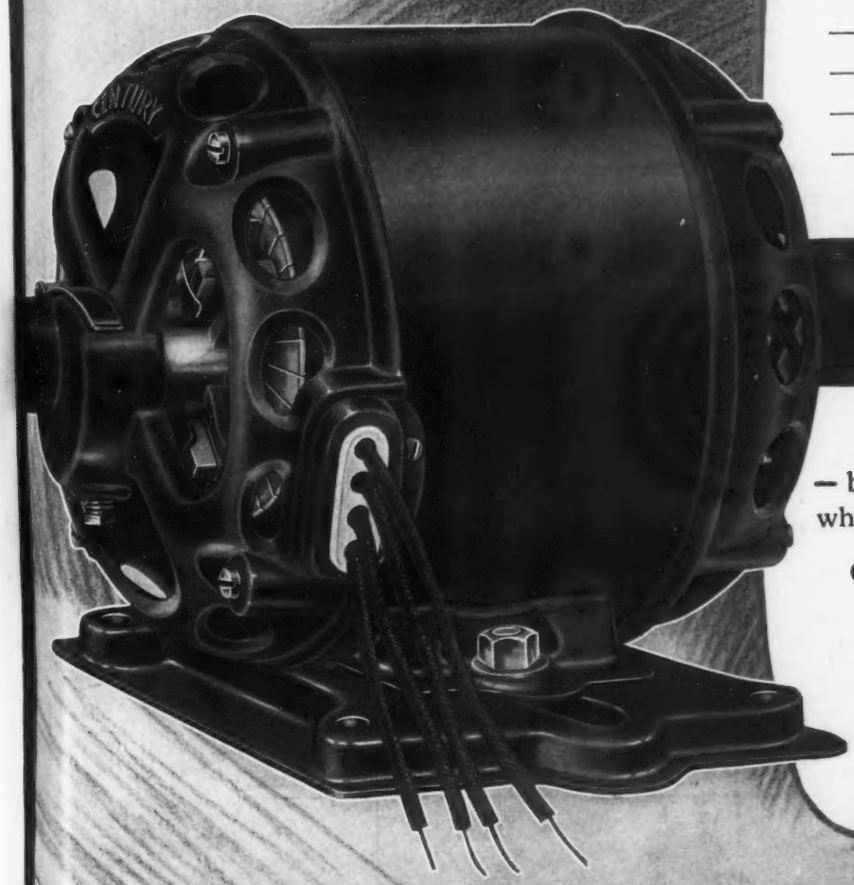
Engineering Library PERIODICAL ROOM RECEIVED JAN 15 1916 UNIV. OF MICH. LIBRARY

Century

Repulsion-Induction Single-Phase Motors

⅙ horse power and smaller are regularly supplied by many manufacturers of

—carbonators,
—beer pumps,
—coffee mills,
—air compressors,
—house pumps,
—organ and piano blowers,
—bakery machinery, etc.



— a ⅙ horse power starts full load on a 3-ampere fuse.

— starting torque exceeds 300%.

— phosphor bronze ring-oiling bearings.

— brushes touch the commutator only while starting.

Other sizes up to 30 horse power.

Century Electric Co.
St. Louis, U.S.A.

196

Specialization is the Key to Modern Efficiency!

The day has long since past when an engineer could afford to recommend that the entire switchboard equipment of a power plant be bought from one concern. Every engineer who has taken the trouble to investigate knows that the complete group of

Weston

A. C. Switchboard Indicating Instruments

SYNCHROSCOPE

AMMETER

are unrivalled with respect to mechanical and electrical design and workmanship, and hence with respect to performance.

Competent engineers know that this Weston group is the only one which perfectly meets the practical requirements of operating service, and they likewise know that the initial cost is little if any more than the cost of inferior instruments and that because of their continuous accuracy and serviceability they are much more economical to adopt than instruments of any other make.

The Instruments, consisting of Ammeters, Voltmeters, Wattmeters (Single and Polyphase), Power Factor Meters, Frequency Meters and Synchroscopes, are thoroughly described in our Catalog 16.

Complete groups of Weston Switchboard Instrument Transformers are described in our Bulletin 1501.

VOLTMETER

WATTMETER
Single and Polyphase

Weston Electrical Instrument Co.

13 Weston Ave., Newark, N. J.

New York	Boston	Chicago	Toronto	Berlin
Buffalo	Philadelphia	Detroit	Winnipeg	London
Cleveland	St. Louis	Denver	Montreal	Paris
Cincinnati	Richmond	San Francisco	Vancouver	Petrograd

Florence, Johannesburg, South Africa

Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company, Inc.

Vol. 67 NEW YORK, SATURDAY, JANUARY 15, 1916 No. 3

High Prices and Rates

HIGH prices and expanding demand travel together. Low prices prevail when demand is no longer active. In the electrical industry the great advance in costs of raw materials, with consequent price readjustments by manufacturers, is coincident with plans for construction outlays on a large scale. Every legal and moral obligation, every instinct and principle of a wise public policy, make it necessary for the companies to meet the public demand for service. No one can foresee how long the higher level of costs will last or to how great an extreme the present tendencies will go. Higher costs introduce an element of expense which central-station companies will bear in mind in making rates for consumers of their energy. It is important that financial structures should not be weakened by ill-advised or uncertain reductions in rates.

Economic Side of Water-Power Development

ONE of the strangest features of our times is the attitude of the federal government toward the undeveloped water-powers of the country. The energy of our streams is wasted because capital cannot be obtained for their development under present restrictive federal laws. On the one hand the government raises the bogie of the water-power trust and on the other it deludes itself as to the value of the water-powers still awaiting development. Misunderstanding of economic factors beclouds the issue. The Ferris bill, after extended hearings, was passed by the House of Representatives Aug. 24, 1914, only to meet with a setback in the Senate. Greatly altered, the bill again passed the House of Representatives on Jan. 8 of this year, and it is now up for consideration in the Senate. What fate awaits it there no one can tell.

It is well to direct attention to the fact that the majority of the water-power sites in this country which show exceptional advantage in low cost and availability of market have already been developed and loaded up. This throws the present choice of new water-powers largely into the second or less favorable class of situations, and this class is a constantly dwindling one because of the increasingly active competition between water-power and the steam turbine. Restrictive legislation still further reduces the number of sites in this class which can be favorably considered.

The solution of the economic struggle between the modern steam-turbine plant and the water-power plant appears to lie in a combination of the two, with the relative outputs adjusted to maximum combined output at minimum annual cost. Elsewhere in this issue are given some combination curves which show how greatly the typical water-power site can increase its continuous rating by the supplying of a surprisingly small percentage of steam energy in the annual load curve. The low capital cost of the modern steam plant, and consequently the low interest account, make possible the addition of the necessary steam equipment to a hydro-electric system without exceeding reasonable limits for combined investment cost.

The importance to the electrochemical industries of the utilization of water-power under seasonable variations in load, in order to obtain the largest energy output at the lowest kilowatt-hour cost, is an interesting point to which Mr. Buck, in the paper alluded to, calls attention. The rapid growth of the electrochemical industries in this country appears to open up a large field for future water-power enterprises, under such a system of development, among water-powers which through location, physical characteristics or otherwise could not profitably be developed along the usual lines of constant power output.

Public Relations in a Paragraph

SPEAKING of railroad problems in his inaugural address at Boston last week, Governor McCall of Massachusetts expressed the whole problem of public-service relations in a concise and telling way which deserves attention. He said: "The railroads should be governed by just laws, framed broadly in their own and the public interest. The public is entitled to just, reasonable and equal rates and efficient service, and the railroads are entitled to charge rates which under good management will enable them to render proper service and to secure a fair return upon the investment. Property invested in a public service is at least as fairly entitled to the protection of the laws as is property in its more selfish forms. Regulation should not be carried to the point where it becomes destructive of property rights, and it should give to the railroad owner a ready access to the courts. Partial confiscation through unjust law will deter people from making further investments, and further investments are constantly necessary in order to keep railroads abreast of the times and make them efficient public servants. If the law will not give due protection to railroad properties, the investor will seek other forms of investment and the public will receive poorer service, ride in cars of prehistoric construction, and in the end be likely to pay higher fares." These views apply to every public utility

and express concisely pretty nearly the whole law and the prophets as applied to modern electric service administration by managers and public officials working on the basic principles of truth and justice.

Photometry and Rating of Electric Lamps

ON the introduction of the Edison incandescent lamp to industrial service, in the early eighties, its photometric rating commenced on the already existing basis of the photometric rating of gas flames, namely, the maximum luminous intensity in all directions from the lamp, in the horizontal plane, was sought for and measured in terms of the British standard candle. This was called the candle-power of the lamp.

The steadiness of the incandescent lamp under steady impressed voltage and the ease with which it could be rotated in the photometer soon led to arguments as to the validity of this method of rating, and electric incandescent lamps soon came to be rated in mean horizontal candle-power, so that the rating of a lamp ceased to be its maximum luminous intensity and became reduced to its average luminous intensity in the horizontal plane.

Different types of incandescent lamp were recognized as having different spherical reduction factors or ratios of mean spherical to mean horizontal candle-power. These differences gave rise to some difficulties with the rating, which was manifestly only a rough and partial estimate of a lamp's performance. A lamp rating on the basis of mean horizontal candle-power is almost as indefensible as the rating of the sizes of men on the basis of their girth at the waist-belt. In spite of discrepancies, contradictions and objections, the mean horizontal rating nevertheless persisted in the incandescent lighting industry for a number of years.

In the case of arc lamps the mean horizontal rating was found entirely unsatisfactory. Early attempts were made to rate naked arc lamps on the basis of their maximum candle-power in the most favored direction. This practice, although it persisted for a time, by mere inertia, could not be sustained. The difficulties incident to arc-light photometry, added to the unsteadiness of the arc and the complexities of reflectors or inclosing globes, made the candle-power rating of arc lamps very unsatisfactory. A great variety of makeshifts and circumventions have been used in specifications at different times, but the ratings on the basis of structure, types of carbon and watts input have probably been the most serviceable.

The introduction of the nitrogen-filled lamps has added new difficulties to the rating of electric "incandescents." The mean horizontal basis has practically broken down. Many tungsten-filament lamps are purchased at the present time without any rating other than watts input, a condition nearly as indefinite photometrically as that of the arc lamp.

The German manufacturers, as explained on page 162, appear to have decided to rate their incandescent lamps in future on a spherical candle-power basis and to be in favor of rating arc lamps similarly. There can be no doubt that a spherical candle-power basis is technically correct and much superior to a mere mean horizontal candle-power basis. There is the question, however, whether the change is not inexpedient commercially. An incandescent lamp of, say, 50 cp. on the old basis might be perhaps only 37 cp. on the proposed new basis. That is to say, there would in many cases be nothing to indicate the transition from mean horizontal to mean spherical candles, and even if the additional words were always used, it is improbable that the transition could be explained to the average purchaser in such a way that he could appreciate its meaning.

It seems, therefore, very desirable to rate all illuminants on a basis of luminous flux, or lumens, instead of on candle-power. A lamp of 10 mean spherical candles is necessarily a lamp of 125.7 lumens, or a lamp of, say, 500 lumens is necessarily also a lamp of 39.8 mean spherical candles. The lumen is a more logical unit than the candle, and the new term would soon become adopted, especially since there is no photometric rating at present in general use.

Once the lumen is introduced, which only calls for its use being actually carried out, since it has been recommended by the standards committee of the Illuminating Engineering Society, the methods of measurement are essentially the same as those for mean candle-power, and whatever device is serviceable for one becomes immediately applicable to the other.

The Summation of Load-Factors

THERE are two ways of leveling a piece of ground. One can smooth off the hummocks or fill up the hollows, and one will very likely combine the processes by using surplus material for filling. But if the normal level of the ground is to be raised, filling up the hollows and laying more material above is the logical procedure. Just so in dealing with the load curve of an electrical supply station. One can lay on successive strata without much change in the general contour, or he can so plan the work as to level while he is building up, filling up the hollows and smoothing the hilltops, but all the while keeping the load constantly moving upward. A brief paper on taking over a grain-elevator load in Kansas City, published elsewhere in our columns, furnishes a good example of the building-up process. The elevator load is a peculiar one, since it varies enormously from season to season and from month to month, yet it is always substantially a day load. Intrinsically the load-factor is bad, yet as a matter of fact it succeeds, in spite of its irregularities, in filling up and making more uniform the day load, which in most stations is much lower than it should be. The elevator is a helter-skelter kind of load, but its one point of uniformity, keeping off the main peak, is an exceptional virtue from the central-station point of view.

The electrical drive for the elevators has proved to be a great success, giving lessened fire risk, great ease of control, a higher efficiency for the driving machinery due to better control, and a very considerable reduction in the operating costs, in one case showing a saving of a third of a cent per bushel of grain received. But the main point of the situation is its importance in steadying the total load-factor of the station. As the normal station peak grows higher and higher from accretions of load, the need of filling material to level the output becomes more and more acute. It must be looked for in all sorts of places. Electrochemical work is one of the promising things for investigation, to say nothing of the general use of heating appliances, which at prices now not infrequently quoted can be successfully exploited. Cooking apparatus, too, is an admirable resource, since in most communities it is likely to fall wholly off the peak, particularly in large centers of population where cheap supply makes it all the more readily accessible to the public. Its general effect is to bring up the morning load and the noon load, while toward evening the cooking peak will generally be found to succeed the main station peak, lengthening it somewhat and making it fall off more gradually without perceptibly increasing the maximum.

The only case in which it is likely to add perceptibly at times of heavy load is when big manufacturing plants are working overtime, or more than one shift, in a small community, and in this case the general load-factor is so greatly improved that one can quite forgive the modest demands made by electric ranges. The domestic heating load, of course, is strictly off the peak, being confined to comparatively brief periods in morning and evening. It is the manager who keeps his eyes open who will find the off-peak loads sometimes in rather unexpected places. For example, there are many small manufacturing concerns operated on water-power which is not sufficiently continuous to take care of the full load all day. If energy is to be had at a favorable price, which could be well afforded in such cases, it will frequently prove to be entirely practicable to use the necessary amount of electric power during the early part of the day to permit storing the water for the afternoon. In some industries, too, power is used to any material extent only for a few hours per day, and inducements can readily be made to cause these hours to be off the peak. Such cases are perhaps not frequent enough to serve as a basis for generalization, but they do occur and can be worked to the advantage of all concerned. The main thing is, in keeping after business, to watch carefully for every opportunity that may come to steady the load curve, even if the load assumed should, considered by itself, be as bad as were the grain elevators which form the text for these suggestions.

Radio Antenna Constants

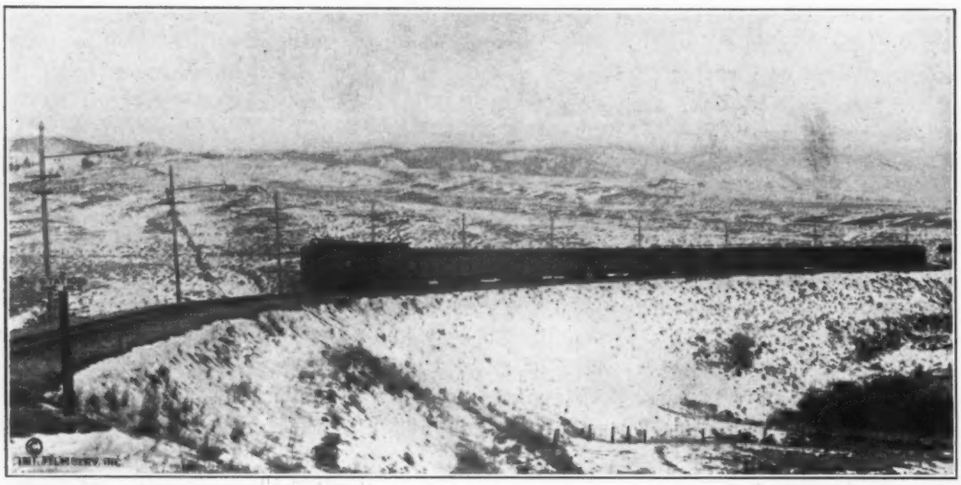
THE method of predetermining the effective capacity and inductance, and thereby the oscillation frequency, of a simple loaded or unloaded antenna which was described by Louis Cohen in our issue for Jan. 30, 1915, assumed a uniformly distributed capacity and inductance along the aerial system. In the earlier days of radiotelegraphy antennas meeting this restriction were not uncommon. It was usual practice to erect "harps" of six or eight parallel wires in vertical or nearly vertical positions, and in even the more complicated forms of aerial there was no sharp transition point within the antenna structure. Since the desirability of concentrating the capacity of the antenna at the highest possible point has become appreciated, however, it has become customary to build extended "flat-top" or umbrella antennas with closely bunched "rat-tail" or leading-in wires. It is obvious that in such networks the vertical lead has larger inductance and smaller capacity per unit length than has the widely extended upper portion. Realization of the desirability of extending Mr. Cohen's method of calculation to the more modern form of antenna has led A. F. Puchstein to work out the parallel mathematical development which is given in this week's issue. The present article should be studied in connection with that of Mr. Cohen. Taken thus, it will prove of considerable interest to those who have followed the various methods by which the numerical problems of aerial-wire vibrations have been attacked.

At the present time radio engineers need comprehensive analytical treatment of antenna systems. The predetermination of the mechanical stresses in aerials under varying conditions of wind and sleet is not difficult, because the mass of data obtained in transmission-line building has led to numerous useful numerical relations. The purely electrical properties present greater hardships, however. Systematic observations of the variation of capacity, inductance, total resistance and radiation resistance with height, etc., are needed.

The Coming Issues

FOLLOWING the present number, which is the technical and engineering issue of the month, next week's ELECTRICAL WORLD, the fourth issue for January, will be the commercial number, wherein, in accordance with the usual program, particular emphasis will be given to the sales problems of the electrical industry. A leading article, "The Value of the Poor Man's Business," will describe methods and experience in bringing electric light to hundreds of modest homes, summarizing the success of a plan of selling begun at Hartford, Conn., six years ago. Electric heating, which is now attracting the interested attention of the entire industry, will be the subject of several articles—one a description of a large high-school building in the far West heated entirely from a near-by water-power. Methods of storing stock and maintaining electrical equipment, discussed on other pages, will be of interest to operating men, contractors and dealers alike. In the Jan. 29 number, the fifth issue of the month, engineering applications of electricity will be featured. Resuming the customary schedule, the first issue of February will be the public relations number, in which will begin the first of a series of "Talks with Leading Men in the Electrical Industry," and the Feb. 12 number will be the regular power and operating issue.

Chicago, Milwaukee & St. Paul Railway Operates First Electric Train Over the Rocky Mountains



Using hydroelectric energy from the system of the Montana Power Company, the Chicago, Milwaukee & St. Paul Railway is now operating trains by electricity over the first 113-mile division of its 440-mile electrification in the Rocky Mountains. The first test train, which inaugurated electric service over the road, is pictured herewith. All freight trains over the mountain division are now being handled by electric locomotives, and full electric passenger service will be begun shortly. On down grades the eight motors in each 3500-hp. locomotive provide regenerative braking, returning energy to the 3000-volt direct-current overhead trolley, and thus serving to help haul ascending trains on other parts of the system.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Western Society of Engineers Holds Dinner

Samuel Insull, president of the Commonwealth Edison Company of Chicago, made the main address at the annual dinner of the Western Society of Engineers on Jan. 12, on the subject "Universal Electricity Supply."

John W. Alvord, past-president of the Western Society of Engineers, has given the organization without restrictions securities to the amount of $1,000 to provide funds for a medal to be awarded annually to men who perform great, though perhaps inconspicuous, service to mankind through the practice of engineering.

W. B. Jackson, the outgoing president, in his address discussed the ethics of the profession, and B. E. Grant, the newly elected president, spoke briefly on the problems of the society and the means of overcoming them.

The Chanute medals were awarded respectively to Andrews Allen, consulting engineer, for the best general engineering paper, "The Engineering Opportunities of Our Coal-Mining Fields"; to N. M. Stineman for the best civil engineering paper, "Reactions in a Three-Legged Stiff Frame with Hinged Column Bases," and to H. E. Goldberg for a mechanical engineering paper on "Arithmetical Machines."

The officers elected for 1916 are: President, B. E. Grant, division engineer of the Board of Local Improvements, Chicago; first vice-president, C. H. Cartlidge, bridge engineer for the Chicago, Burlington & Quincy Railroad; second vice-president, D. W. Roper, assistant chief operating engineer of the Commonwealth Edison Company; third vice-president, Prof. F. H. Newell, University of Illinois, and trustee, Ernest McCullough, consulting engineer.

Municipal System for Los Angeles Suburbs

The Los Angeles Public Service Commission on Jan. 8 adopted a resolution directing its chief electrical engineer to prepare and report as soon as practicable plans and specifications for municipal distributing substations in Garvanza and Hollywood, also for all material and equipment necessary for constructing electric distributing systems in East Los Angeles, Highland Park, Garvanza, Hollywood and East Hollywood districts, and "that such other provision be made by the chief electrical engineer as may be necessary for meeting the requirements of these districts for municipal electrical energy for commercial light, heat and street lighting."

This action is in accordance with the recommendations of the commission's committee on extensions, and it was taken after the Pacific Light & Power Company and the Los Angeles Gas & Electric Corporation had refused to sell their respective distributing equipment in these districts to the city. It is the first definite step toward paralleling the lines of the private companies. Chief Electrical Engineer Scattergood is reported to have stated that the distributing system in Hollywood and East Hollywood districts will cost about $350,000, and that in the other three districts the cost will be about $375,000.

Institute of Radio Engineers Elects Officers

At the meeting of the Institute of Radio Engineers held at Columbia University, New York City, Jan. 5 the following officers and managers were elected for 1916: President, Dr. A. E. Kennelly of Harvard University; vice-president, John L. Hogan, Jr.; treasurer, Warren F. Hubley; secretary, David Sarnoff. The board of managers comprises the following: Louis W. Austin, John Hays Hammond, Jr., Robert H. Marriott, Guy Hill, Edwin H. Armstrong, Capt. W. H. G. Bullard, Lloyd Espenschied, John Stone Stone and Roy A. Weagant. Prof. Alfred N. Goldsmith is editor of publications.

A very interesting paper was presented by Prof. A. Hoyt Taylor on "Variations in Nocturnal Transmission," prepared by himself and A. S. Blatterman. Among those who discussed the paper were Capt. W. H. G. Bullard, head of the United States Naval Radio Service, and V. Ford Greaves of the Department of Commerce. After the meeting at Columbia University the new board of directors met at the Holland House, where three additional directors to serve on the board for 1916 were appointed and a general discussion was held as to the best methods by which to increase the activities of the institute.

Samuel Insull Speaks on "Universal Electricity Supply"

Enormous Possibilities for Central-Station Expansion in Electrification of Railroads and Concentration of Power Production

Samuel Insull, president of the Commonwealth Edison Company of Chicago, addressed the Alumni Association of the Massachusetts Institute of Technology at its annual meeting in Boston on Jan. 8 upon "Universal Electricity Supply." He also gave an address on the same subject before the Western Society of Engineers in Chicago on Jan. 12. Extending his well-known views upon the economic value of the central station, Mr. Insull presented new and striking figures of the savings possible through centralized production and distribution. Thirty years ago the area supplied from a central station in New York City was less than a mile square. Now there are generated yearly in the United States more than 17,500,000,000 kw.-hr. Central-station plant rating has risen from 3,000,000 hp. in 1902 to 11,000,000 hp. in 1912, with a probable further increase of 20 to 25 per cent since. The main impetus of the industry in the last few years comes from the development of large prime movers and improvements in transmission and distribution.

The efficiency of the steam turbine has increased 35 per cent in the last two or three years. A few years ago only 8 to 10 per cent of the energy of coal was delivered to the line. The early Parsons and Curtis turbines raised the plant efficiency to 12.5 per cent. Improvements in the past two or three years have increased this to 17 per cent. How far that efficiency can be increased by other means, such as gas turbines or the production of electrical energy direct from some mineral, is a matter of conjecture. The industry is in so vastly improved a condition compared with ten or fifteen years ago that the possibilities of extending service over very much greater areas are becoming more and more apparent to those who follow the industry.

At Chicago 500 kw.-hr. per capita is generated yearly, compared with about 74 kw.-hr. in the county of London, or, say, 150 kw.-hr. in Greater London, for a fairer comparison, including electric railways. The electrification of steam railroads at Chicago is a pressing question. The politicians assume that it is only necessary to ask the railroads to accomplish this and it will be done, but 3500 miles of track are involved, and the solution of the problem requires years of experience, since a comprehensive and not a piecemeal solution is desirable. The speaker said that he did not assert that the electrification of railroads is an economic proposition to-day, that being a question which must be determined by the railroads themselves. "My business," said Mr. Insull, "is manufacturing energy and not manufacturing transportation. I do not want to be quoted as arguing in favor of immediate electrification at any point in this country, but I do wish to emphasize the economic value of diversity of industries as users of electric service."

The speaker said that if the railroads in the Chicago district should be electrified they would add 125,000 kw. to the present load, and that one system would be obliged to carry 728,000 kw. if no account was taken of the diversity factor. Owing to overlapping peaks, however, the service could be rendered by 577,000 kw., making a saving of 150,000 kw. through centralization. This represents a capital saving of $30,000,000, and the saving in fuel consumption would be 5,900,000 tons yearly on a total assumption of 11,000,000 tons.

"Now suppose," said Mr. Insull, "that we carry this idea farther afield, considering the electrification of all the railroads in the country. It takes about 2,800,000 tons of coal yearly to operate the railroads in the Chicago district by steam locomotives. Applying the same figures to the entire country and correcting by figures of the Interstate Commerce Commission, we find that 135,000,000 tons of coal are yearly required for steam railroads in this country. If the same process is followed with the diversity factor as in Chicago, we find that if we could marshal all the energy requirements of central stations, railways, manufactories, mines, street cars, etc., the 43,000,000 hp. now required for separate operation would be reduced to 30,000,000 hp. if operated under one system of production and distribution. I am not suggesting a single system for the United States—that, of course, is impossible—but I do suggest a series of state-wide organizations where the density of use is sufficient for all the energy requirements of one territory to be met by one system per territory. One might embrace Boston and New York, another New York and Philadelphia, a third Philadelphia and Pittsburgh. The savings of such group systems would be almost fabulous, amounting to from 12,000,000 hp. to 15,000,000 hp. at, say, $200 per horsepower. The annual saving in fuel consumption would be about 250,000,000 tons, or $500,000,000.

"The coming of a universal system of electrical supply is as inevitable as day and night. It will mean enormous savings to manufacturers of transportation, a very large saving in labor, interest, depreciation, general capital charges, the preservation of natural resources, lower relative consumption of copper, lead and other metals, and will lead to a lower cost of production, and so to a lower unit price to the smallest user, corresponding to the most efficient mobilization of the business. There would be a gain to all classes down to the occupants of the smallest city flat—cheaper power and low-priced light for rich and poor alike. Although it does not seem possible to try this out on a national basis, the unification of electrical supply is steadily proceeding, and in adding to the wealth of the country and as a factor in reducing costs it is putting us in a better position to compete in the markets of the world."

Los Angeles Condemnation Hearing

Testimony Regarding the Severance Damages to Be Paid by City in Taking Over Los Angeles Property of South California Edison System

In the continuation of the condemnation suit brought by the city of Los Angeles against the Southern California Edison Company, earlier reports of which have appeared in the ELECTRICAL WORLD for Dec. 4, 18 and 25, 1915, Dr. George L. Hoxie showed the relation of the capacity of the water plants to the demand on them by consumers. The average in the fiscal year 1915 was 89 per cent. The chart showed that with partial severance the demand would be 79 per cent, and with the Los Angeles city business and the Pacific Electric both severed, 62 per cent.

About 90 per cent of the available developed power is actually used in the Edison system, and if the Los Angeles business is lost this percentage would be 80 per cent, granting that the Pacific Electric company's load is kept.

The water-power available in the streams up to the capacity of the plants is 240,000,000 kw.-hr. The energy actually used was 214,000,000 kw.-hr., of which 151,000,000 kw.-hr. was used on business outside Los Angeles. This last is for complete severance. Water-power waste at generating stations was given as 24,000,000 kw.-hr. Valued at 65 mills per kilowatt-hour, this

would mean $132,000, equal to 6 per cent on $2,200,000. That is the money which would be idle under conditions of partial severance.

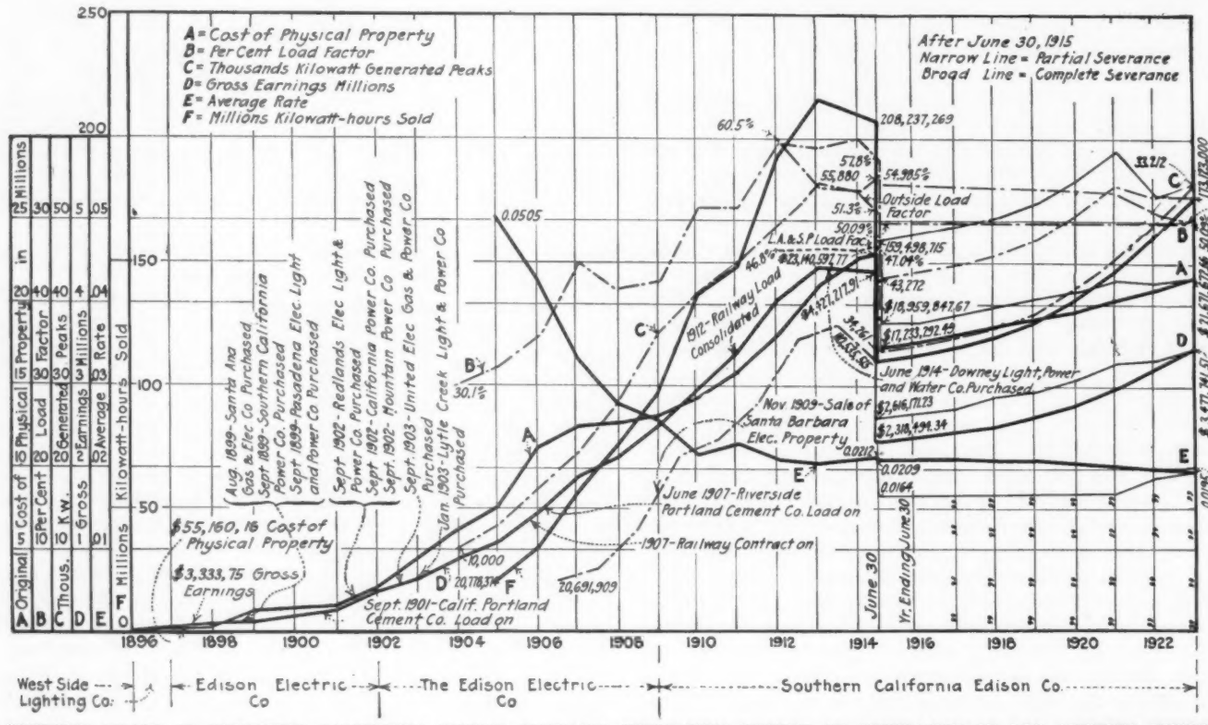
D. M. Trott, statistician of the company, offered testimony showing total physical property used in the operation of the company's business, including cost of water rights, franchises, licenses, organizations, etc., $25,569,228. The value of the Los Angeles electrical distributing system in Los Angeles, including poles, wires and meter service, is $3,039,602. The total value, including the San Pedro district, is $4,429,383.

S. M. Kennedy, general agent for the Edison company, testified that territory outside of Los Angeles has been developed close to the point of saturation.

Assistant General Manager R. H. Ballard, recalled by the company, testified as to plant expenditures which would be required up to 1923, totaling $1,768,380. If the company were to retain the Los Angeles business, it would enlarge the Long Beach steam plant by 30,000 kw., perhaps in 1917.

Charles L. Edgar, president of the Boston Edison company, by deposition, explained his theories of estimating severance damages as follows: After severance the company would earn substantially less than 8 per cent per annum on its outside business, and since 8 per cent is considered a fair return, the deficits below this are charged to the city for eight years and the permanent loss at the end of that period is capitalized at 6 per cent. This gives a total severance damage, according to Mr. Edgar's method of computation, of $11,096,283.88. Mr. Edgar said that he estimated the present value of the Southern California Edison's electric business, as arrived at by his own experience in valuing properties, at $37,631,000. Using the same method of reasoning, he estimated that the total value of the electric properties of the Southern California Edison Company, after the Los Angeles distributing system and franchises had been taken away, would be $13,245,000. The difference between these two amounts, $24,386,000, would represent just compensation to the company, including all values and severance damage.

After reading into the record the Edgar deposition, the deposition of Samuel Insull, president of the Commonwealth Edison Company of Chicago, was taken up. He also testified on severance damage. Mr. Insull uses a method different from that used by Mr. Edgar and divides the severance into four items, namely: (1) Investment damage due to loss of diversity, $1,581,816.04; (2) operating damage due to loss of diversity, $4,235,808.54; (3) fixed charges on idle investment, $2,340,917.31; (4) damage due to difference between 8 per cent net return on investment obtainable without severance and continuance of present basis on which his calculations are based, $2,786,497.68, making a total severance damage of $10,945,039.58.


A = Cost of Physical Property
B = Per Cent Load Factor
C = Thousands Kilowatt Generated Peaks
D = Gross Earnings Millions
E = Average Rate
F = Millions Kilowatt-hours Sold
After June 30, 1915
Narrow Line = Partial Severance
Broad Line = Complete Severance
$55,160,16 Cost of Physical Property
$3,333,75 Gross Earnings
Aug. 1899 - Santa Ana Gas & Elec. Co Purchased
Sept. 1899 - Southern California Power Co. Purchased
Sept. 1899 - Pasadena Elec. Light and Power Co Purchased
Sept. 1902 - Redlands Elec. Light & Power Co. Purchased
Sept. 1902 - California Power Co Purchased
Sept. 1902 - Mountain Power Co Purchased
Sept. 1903 - United Elec. Gas & Power Co Purchased
Jan. 1903 - Lytle Creek Light & Power Co Purchased
Sept. 1901 - Calif. Portland Cement Co. Load on
June 1907 - Riverside Portland Cement Co. Load on
1907 - Railway Contract on
1912 - Railway Load Consolidated
Nov. 1909 - Sale of Santa Barbara Elec. Property
June 1914 - Downey Light, Power and Water Co. Purchased
Outside Load Factor
L.A. & S.P. Load Fac.
208,237,269
59,498,115
$18,959,847.67
$17,733,792.49
$2,616,171.73
$2,318,494.34
$21,671,672.66
$3,477,741.51
West Side Lighting Co.
Edison Electric Co
The Edison Electric Co
Southern California Edison Co.

HISTORIC CHART OF SOUTHERN CALIFORNIA EDISON COMPANY, INDICATING RESULT OF SEVERANCE OF LOS ANGELES BUSINESS

Prof. David Friday, of the University of Michigan, deposed as to franchise rights in connection with a deposition by Prof. Henry C. Adams, who was formerly with the Interstate Commerce Commission. Professor Adams classes all values, such as going-concern value, development cost, value as a business and other non-physical values, under the term "franchise values," and takes as the franchise value the combination of what he calls the cost of maintaining the investment and the actual gross earnings of the company. In the case of the Southern California Edison Company the cost of maintaining the plant is taken at 6 per cent of gross and the total earnings are taken at 8 per cent, leaving 2 per cent of gross to be capitalized, which gives as the sum for going-concern value attributable to the portion of the Edison company's business sought to be condemned by the city of Los Angeles, assuming complete severance, $4,606,555. Of this total, Professor Adams assigns $4,164,991.04 to the value of the light franchise, which is a constitutional franchise, and $441,563.96 to the value of the power franchise, which expires in 1921.

Arthur R. Kelley, valuation engineer, formerly engineer of the Railroad Commissions in the States of Washington and California, testified that the cost of carrying the idle plants amounts to $4,461,483.22. In addition to the severance damage, Mr. Kelley stated that the value as a going concern is $5,187,000.

New Construction Plans on a Large Scale

The plans of many of the public-utility companies make it reasonable to estimate that these properties as a whole will spend for new construction in 1916 *double the amount they devoted to this purpose in* 1915.—Statement by Holton H. Scott, vice-president and general manager Doherty Operating Company, to the ELECTRICAL WORLD.

NEW construction by public-utility companies, according to all present indications, will be on a large scale during 1916. Many companies will invest in additions and betterments twice as much capital as they did in 1915. In certain individual instances companies will spend in 1916 more than enough to balance the reduction enforced in their 1915 expenditures by the war, so that their combined outlay for the two years will be greater than the usual investment in such a period. It appears that the higher range of prices for metals and raw materials, which was discussed in last week's ELECTRICAL WORLD, will not have much effect on the construction programs of the established companies. Notwithstanding the expected higher costs of apparatus and materials, most of the public-utility companies are looking forward confidently to unusual expansion in 1916 because of the great demands for service and—what is an essential factor in their calculations—the excellent market which has developed for their securities.

On account of the European war the construction programs were curtailed very sharply in the latter part of 1914 and in 1915. Not only was there widespread apprehension as to the business situation in this country, but the companies found that it was impossible to market securities on a normal scale or at reasonable rates of interest. Among the officials of companies which were financed in part by European investors considerable discussion took place as to the effect of the closing of the foreign sources of funds. It was agreed pretty generally that: (1) this country would be obliged to buy back a large volume of investment securities from European holders; (2) hereafter public-utility companies would be forced to rely on investors in this country and, because of the waste of resources in Europe and the resultant world-wide scarcity of capital, would have to pay higher rates of interest for funds.

THE EFFECT OF NEW WEALTH

Subsequent developments have made a revision of these conclusions necessary. European selling of public-utility securities has been on a smaller scale than was anticipated. The curtailment of the investment demand in this country for a time and the slowing down of general industry led to an enormous accumulation of banking funds. This was followed by a sudden return of industrial activity as the outcome of enormous war orders, by resultant new and large wealth, and by a gradual development of an investment demand. The investment demand found the bankers with shelves almost bare of securities. At the present time representatives of the bond-distributing houses are asking the great public-utility-holding companies for offerings of securities. The advantage of this situation to the public-utility companies is obvious. The difference between having to go to the bankers and having the bankers come to you is worth several points on bonds.

Undoubtedly the position of the electric central-station companies has been strengthened substantially by the fact that as a rule their bonds were not affected much during the gloomy period after the war was started. While the companies were handicapped by the inability to sell securities in substantial volume, they did not see a material decline in quotations. "The dealers are asking now for even small blocks of securities," said one executive to the representative of the ELECTRICAL WORLD.

A GOOD MARKET FOR BONDS

The assured market for securities relieves the public-utility companies from a situation that might have become very embarrassing. War-order business and the broader general prosperity which has sprung from it have caused an increase in the demand for public-service facilities. At this time the demand is greater than some of the public utilities can meet. At certain points if additional facilities were ready the companies would be able to find customers for them instantly. Some business is practically being lost because it cannot be cared for in a satisfactory manner. The development of additional business followed so quickly after the period of curtailment that a number of companies found that they were not prepared for it. This is not consistent with the theory on which the well-managed companies are operated, and, desiring to furnish the service wanted by the public, they will expand at an unusual rate in the coming year.

In answer to a question by the representative of the ELECTRICAL WORLD as to whether the present peak demand is regarded as permanent, and therefore demanding construction up to its full equivalent, an executive of a company with extensive interests in different parts of the country said: "No; we think that the part which is due to acute war-order business will decline after awhile, and therefore we are not making permanent provision for all of it. However, in the course of time partial loss of this character of business will be overcome by the normal growth."

A GENERATOR TO PAY FOR ITSELF

An executive of a holding company which has among its properties a central-station company in a busy war-order district told of an experience. For this company a second-hand generator was bought with the idea that it would pay for itself in three months. It is figured that the war-order business is certain to last for that length of time. And even if the unusual business is not held for a long period the company will have responded without loss to the necessary demands of its customers for service.

Looking forward with confidence to the requirements of the present year, various companies let their contracts for construction materials, or for part of them, last fall. These properties have saved substantially by avoiding the existing level of prices. A canvass covering a number of properties shows that while high prices of materials will lead to substitutes, to a postponement of construction or to temporary plans in certain instances, the general policy will be to provide service as it is wanted.

As an indication of the enormous new-construction program of the industry, the manufacturers of electrical equipment are confronted with a volume of buying orders far in excess of their normal output. Steam-turbine factories are booked up to capacity for twelve months ahead. Manufacturers of generators, transformers, steam boilers and wire and cable are reporting the largest business on record.

Artistic Illumination in New Equitable Building, New York City

Interiors of Restaurant, Banking Room, Barber Shop and Bankers' Club

The illumination in the Bankers' Club, in the Equitable Building, which occupies the entire thirty-eighth, thirty-ninth and fortieth floors, is characteristic of the effects produced throughout the building to suit particular conditions. Here the lighting fixtures are not only decorative but harmonize with the architecture and furnishings in such a way that a proper color effect is produced and so that eye strain is eliminated. Several different forms of illumination are employed. In the lounging room, shown directly above, are employed both indirect cove lighting and direct lighting. The former, which is furnished by fixtures concealed in cornices around the columns and walls, provides general illumination, while the latter is afforded by table lamps and chandeliers which help to carry out the architectural scheme of the room and lend color to the upper portions. Indirect illumination by means of cove fixtures is also employed in the dining and grill rooms. A very elaborate semi-indirect fixture lighting a rotunda on the thirty-eighth floor of the Bankers' Club is shown in the upper left-hand corner. The main corridor, illustrated in the center of the right-hand side, is illuminated by ornamental wall-bracket fixtures in the shape of flambeau torches. In the Savarin restaurant, which is in the basement and shown at the center of the top row, still another method of illumination is employed. It consists of illuminated translucent glass cornices around the columns. The remaining views show the methods of illuminating the Empire Trust Company's banking rooms and a barber shop. The Empire Trust fixtures are like those used in the main entrance.

Electric Service in Largest Office Building

Engineering Features of Methods of Distributing Energy in the New Equitable Building for Illumination, Elevators and Building Motors from a 2600-Kw. Plant in Basement

BY R. D. WARD
Mechanical Engineer for the Equitable Office Building Corporation

EQUIPPING large office buildings for electric service involves many considerations, among which are: The layout of main feeders and distribution circuits so that the proper voltage may be maintained at each outlet with the least investment in copper; arrangement of controlling and protective equipment so that too much time will not be required in turning public lamps on or off and in replacing fuses; methods of illuminating offices and main corridors, and choice and grouping of elevators. When a private generating plant instead of central-station service is employed, the problem becomes more extended, for then a station must be designed to serve loads which are nearly as varied in character as those in a small city. The method of solving the last problem for the Equitable Building, New York City, the largest office building in the world, was described in the July 10, 1915, issue of the ELECTRICAL WORLD. Some of the other subjects referred to above are discussed in what follows.

As mentioned in the former article, the generating equipment consists of six General Electric 240-volt compound-wound direct-current generators directly connected with Rice & Sargent Corliss engines. Three of the units are rated at 600 kw., two at 300 kw. and one at 200 kw., the latter being used for night loads. Since energy is distributed over a three-wire, 240/120-volt system, two motor-generator balancer sets are employed, furnishing a connection for the neutral wire. Each set is capable of taking care of a totally unbalanced load. To save space in the engine room, a machine panel was installed back of each generator and equipped with a motor-operated inverse-time-limit circuit-breaker controlled from the main switchboard. From the breakers risers lead to an overhead busbar system which connects the six generator panels and feeds the main distributing boards. Switching facilities and busbar connections between the balancer sets, generators and feeder panels permit supplying energy to either power or lighting busbars from any generator, thus making for flexible plant operation.

ARRANGEMENT OF MAIN FEEDERS

Four main distributing panels are provided, one at the base of each of four vertical wire shafts which extend from the sub-sub-basement to the thirty-eighth floor in each quarter of the building. On these boards are mounted knife switches controlling the risers, while back of the panels on slate slabs are link fuses. Commencing at the second floor and arranged at intervals of three floors are boxes for supporting the risers. Numerous building auxiliaries such as fans and pumps are supplied with energy from distribution board *A*. This board and board *C* each serve eight elevator motors, while boards *B* and *D* feed sixteen each in addition to the regular distribution cabinets on each floor. Several exhaust fans on the roof are also fed by board *B*.

As shown on page 138, the distributing panels on each floor are fed in groups, the number in each group depending in most cases on the length of riser required to reach the load. For instance, the third to the eleventh floor inclusive are served in groups of five floors, the twelfth to the twenty-third floor inclusive in groups of four floors, and floors from the twenty-fourth up are served in groups of three floors. The loads on the floors below the third floor, being larger in comparison with those on a similar number of floors higher in the building, are supplied with energy in a group of four floors instead of five. With these arrangements the long feeders are required to feed smaller loads than the short ones, thereby approximately equalizing the voltage drops in all risers. While it may appear from the riser diagram that a different method of distribution is used in

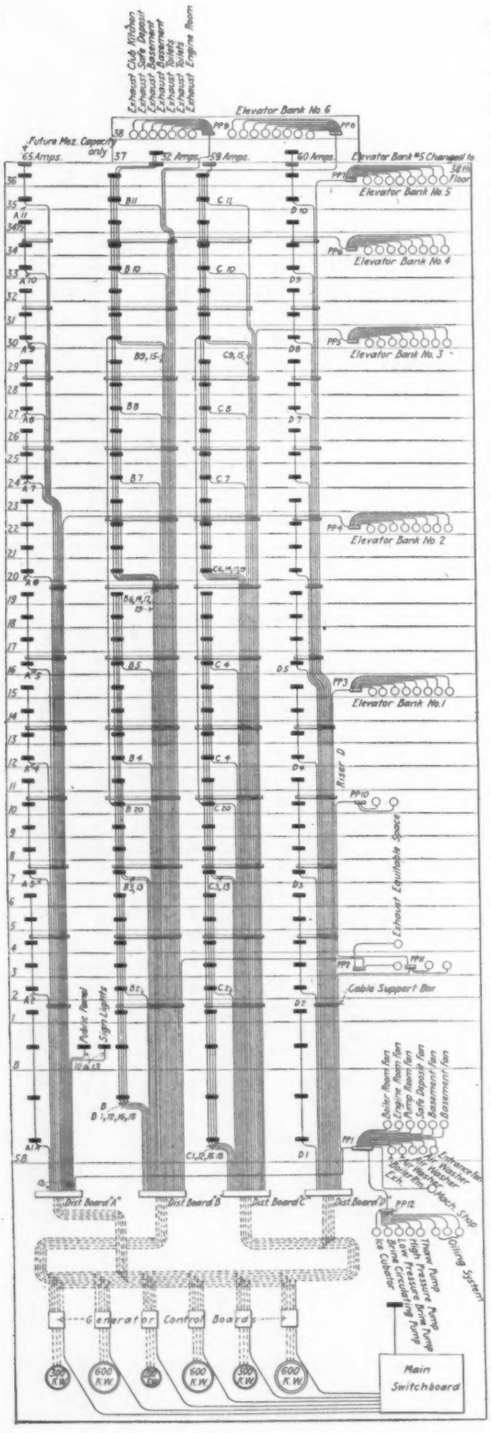
Features of General Illumination

Two methods of illumination are employed in the ground-floor corridors—indirect cove lighting and direct lighting by pendent fixtures. The latter, which consist of ornamentally supported horizontal rings studded with radially projecting frosted bulbs, are employed in the corridors leading from the entrances to the central arcade. To make the coffered ceiling of the latter stand out in relief, 10-in. tubular lamps backed with trough reflectors are concealed in the cornice. Illuminated directional signs of a pleasing design at the cross-passages and elevators harmonize with the architecture of this floor. Corridors and other passageways on the upper floors are illuminated by canopy-type direct-lighting fixtures. In the offices, however, semi-indirect fixtures are used. A feature of the fixtures is that they are designed so they can be used for either direct or semi-indirect lighting by simply changing the lower member of the fixture. In general, there are four fixtures to a bay, controlled by two local push-button switches on the columns. About 270 fixtures are installed on each floor, each equipped with 100-watt lamps, making about 1 watt per square foot of floor space.

shafts *B* and *C* than in *A* and *D*, it is not so. The additional risers in the former consist of two risers for corridor-lighting circuits, two for night-lighting circuits, two for utility rooms, and two for stair lamps. These feeders are controlled from the main distributing boards at the bottom of the riser shafts, but for convenience in case it is desired to control the circuits locally switch cabinets are provided on each floor. These public lighting circuits are also divided into zones, those up to the nineteenth floor, except the stair lamps, being served by one set of feeders and those higher in the building by another set. The stair feeders lead to the tenth and thirtieth floors and feed ten floors above and below.

The arrangement of office outlets, corridor lamps, directional signs, service outlets, and the like, for a typical floor is indicated on page 139. All circuits leading from the distributing cabinets to the local control switches pass through conduits laid in the floor fill. From the control switches to the ceiling fixtures, however, the conduits extend up the wall and run in the floor fill above. The baseboard receptacles are served by circuits passing through the same floor on which they are installed. No conduit contains more than one circuit. About 18,000 ft. of 0.5-in. and 0.75-in. conduit was used per floor, making a total of approximately 1,000,000 ft. for the entire building.

RISER DIAGRAM SHOWING GROUPING OF BRANCH DISTRIBUTING BOARDS WITH TABLE OF FEEDER CROSS-SECTIONS, LENGTHS, CURRENTS AND CORRESPONDING VOLTAGE DROPS



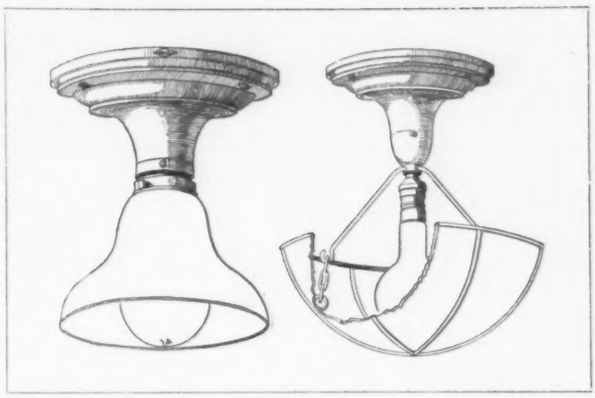
Feeder No.	Highest Floor Fed	Type of Service	Length (Ft.)	Amp.	Voltage Drop	Conduit Diameter (In.)	Conductor Cross-Section (Circ. Mil)
L-A-1.	2-A	Tenant lights	85	245	1.50	One 3-in.	Three 300,000
L-A-2.	6-A	Tenant lights	158	292	2.80	One 3-in.	Three 350,000
L-A-3.	11-A	Tenant lights	225	300	3.61	One 3-in.	Three 400,000
L-A-4.	15-A	Tenant lights	277	236	3.50	One 3-in.	Three 400,000
L-A-5.	19-A	Tenant lights	327	239	3.72	One 3-in.	Three 450,000
L-A-6.	23-A	Tenant lights	375	245	3.58	One 3-in.	Three 550,000
L-A-7.	26-A	Tenant lights	454	197	3.84	One 3-in.	Three 500,000
L-A-8.	29-A	Tenant lights	490	204	3.90	One 3-in.	Three 550,000
L-A-9.	32-A	Tenant lights	528	188	3.86	One 3-in.	Three 550,000
L-A-10	34½-A	Tenant lights	564	190	3.82	One 3-in.	Three 600,000
L-A-11	36-A	Tenant lights	600	176	3.77	One 3-in.	Three 600,000
L-B-1.	2-B	Tenant lights	65	167	1.20	One 2-in.	Three No. 3/0
L-B-2.	6-B	Tenant lights	130	324	2.30	One 3-in.	Three 400,000
L-B-3.	11-B	Tenant lights	196	285	3.42	One 3-in.	Three 350,000
L-B-4.	15-B	Tenant lights	247	225	3.40	One 3-in.	Three 350,000
L-B-5.	19-B	Tenant lights	295	228	3.60	One 3-in.	Three 400,000
L-B-6.	23-B	Tenant lights	344	224	3.66	One 3-in.	Three 450,000
L-B-7.	26-B	Tenant lights	393	157	3.78	One 3-in.	Three 350,000
L-B-8.	29-B	Tenant lights	429	165	3.80	One 3-in.	Three 400,000
L-B-9.	32-B	Tenant lights	467	160	3.56	One 3-in.	Three 450,000
L-B-10	34½-B	Tenant lights	503	170	3.88	One 3-in.	Three 500,000
L-B-11	37-B	Tenant lights	570	141	3.83	One 3-in.	Three 450,000
L-B-12	6-B	Public lights	103	149	2.46	One 2-in	Three No. 2/0
L-B-13	19-B	Public lights	245	292	3.44	One 3-in.	Three 400,000
L-B-14	29-B	Public lights	380	238	3.88	One 3-in.	Three 500,000
L-B-15	37-B	Public lights	503	240	3.98	One 3-in.	Three 650,000
L-B-16	19-B	Corridor lights	194	33	3.30	One 1¼ in.	Three No. 4
L-B-17	37-B	Corridor lights	441	52	3.78	One 2-in.	Three No. 2/0
L-B-18	19-B	Night lights	194	18	2.85	One 1¼ in.	Three No. 6
L-B-19	35-B	Night lights	429	19	2.70	One 1¼ in.	Three No. 2
L-B-20	10 & 30-B	Stair lights	453	57	3.30	One 2-in.	Three No. 3/0
L-C-1.	2-C	Tenant lights	58	185	1.10	One 2½-in.	Three No. 4/0
L-C-2.	6-C	Tenant lights	134	296	2.42	One 3-in.	Three 350,000
L-C-3.	11-C	Tenant lights	201	350	3.36	One 3-in.	Three 450,000
L-C-4.	15-C	Tenant lights	253	264	3.58	One 3-in.	Three 400,000
L-C-5.	19-C	Tenant lights	302	270	3.88	One 3-in.	Three 450,000
L-C-6.	23-C	Tenant lights	351	254	3.82	One 3-in.	Three 500,000
L-C-7.	26-C	Tenant lights	400	182	3.90	One 3-in.	Three 400,000
L-C-8.	29-C	Tenant lights	436	188	3.53	One 3-in.	Three 500,000
L-C-9.	32-C	Tenant lights	504	201	3.62	One 3-in.	Three 600,000
L-C-10	34½-C	Tenant lights	540	210	3.74	One 3-in.	Three 650,000
L-C-11	36-C	Tenant lights	576	184	3.79	One 3-in.	Three 600,000
L-C-12	6-C	Public lights	110	172	2.42	One 2-in.	Three No. 3/0
L-C-13	19-C	Public lights	253	264	3.57	One 3-in.	Three 400,000
L-C-14	29-C	Public lights	387	206	3.80	One 3-in.	Three 450,000
L-C-15	36-C	Public lights	510	128	3.50	One 3-in.	Three 400,000
L-C-16	19-C	Corridor lights	188	33	2.50	One 1¼-in.	Three No. 3
L-C-17	35-C	Corridor lights	436	35	3.10	One 2-in.	Three No. 0
L-C-18	19-C	Night lights	188	19	2.90	One 1¼-in.	Three No. 6
L-C-19	35-C	Night lights	436	19	2.70	One 1¼-in.	Three No. 2
L-C-20	10 & 30-C	Stair lights	460	72	3.35	One 2-in.	Three No. 4/0
L-D-1.	2-D	Tenant lights	40	213	0.90	One 3-in.	Three No. 4/0
L-D-2.	6-D	Tenant lights	116	336	2.10	One 3-in.	Three 400,000
L-D-3.	11-D	Tenant lights	183	289	3.20	One 3-in.	Three 350,000
L-D-4.	15-D	Tenant lights	235	236	3.40	One 3-in.	Three 350,000
L-D-5.	19-D	Tenant lights	314	263	3.53	One 3-in.	Three 500,000
L-D-6.	23-D	Tenant lights	363	275	3.97	One 3-in.	Three 550,000
L-D-7.	26-D	Tenant lights	412	189	3.70	One 3-in.	Three 450,000
L-D-8.	29-D	Tenant lights	448	183	3.90	One 3-in.	Three 450,000
L-D-9.	32-D	Tenant lights	486	196	3.71	One 3-in.	Three 550,000
L-D-10	34½-D	Tenant lights	522	197	3.67	One 3-in.	Three 600,000
L-D-11	37-D	Tenant lights	558	204	3.75	One 3-in.	Three 650,000
L-A-12	1st floor	Public panel	.....	178	.....	One 2½ in.	Three No. 4/0
L-A-13	1st floor	Sign lights	.....	.....	.....	One 2-in.	Three No. 2/0
L-SSB	SSB	Eng. & B. R. lights	.....	84	.....	One 1½-in.	Two No. 1
P-A 1.	22-Elev.	Power	459	980	280 hp.	Four 2-in.	Four 900,000
P-B 1.	34-Elev.	Power	565	980	280 hp.	Four 2-in.	Four 900,000
P-B 2.	38-Motor	Power	685	546	156 hp.	Four 2-in.	Four 700,000
P-B 3.	38-Elev.	Power	685	980	280 hp.	Four 2-in.	Four 900,000
P-C 1.	30-Elev.	Power	533	980	280 hp.	Four 2-in.	Four 900,000
P-D 1.	15-Elev.	Power	333	980	280 hp.	Four 2-in.	Four 900,000
P-D 2.	36-Elev.	Power	661	980	280 hp.	Four 2-in.	Four 900,000
P-D 3.	S.B.-Motor	Power	110	960	240 hp.	Four 2-in.	Four 600,000
P-B 4.	.....	Laundry	170	157	45 hp.	One 2-in.	Two No. 4/0
P-A 2	3½ & 10 Elev.	Power	.....	300	75 hp.	One 3-in.	Two 400,000

For clearness in showing the circuits controlled from each main distributing board the elevator feeders have been indicated as passing up the main riser shafts, but they actually extend up the elevator shafts. Each group of elevators is provided with one set of feeders consisting of two positive and two negative conductors. The division of conductors was made, as it permitted using more easily handled cables and smaller conduit. In case either pair of these conductors should become defective, it can be disconnected from the switch lugs at each terminal and three-fourths of the elevators can still be operated on the other pair of feeders. On the elevator controller boards are mounted hand-operable inverse-time-element circuit-breakers. These permit restoring interrupted service much more quickly than when fuses are employed.

Feeders supplying energy for lighting the boiler, engine, pump and refrigerating rooms are connected with a bus which may be energized directly by any generator without any automatic switch in circuit. This arrangement prevents the station lights being extinguished when the circuit-breakers open. Continuity of station-lighting service is further insured by feeding alternate lamps from separate circuits connected with separate generators. In case one generator becomes inoperative, only half the lights are therefore extinguished.

Arrangement of Elevators to Provide Rapid Service and Prevent Corridor Congestion

The type, number and grouping of elevators employed were determined in such a way that persons can travel between the upper and main floors almost as quickly as between the lower and main floors, and so that passageways will not be congested by persons waiting for elevators. These facilities were provided by installing six groups of eight Otis elevators on cross aisles connecting with the main corridors. Some of the elevators are for local service to the lower floors of the building, others are for local service throughout the entire height, while still others are for express service the greater portion of their travel and local service for the upper floors.

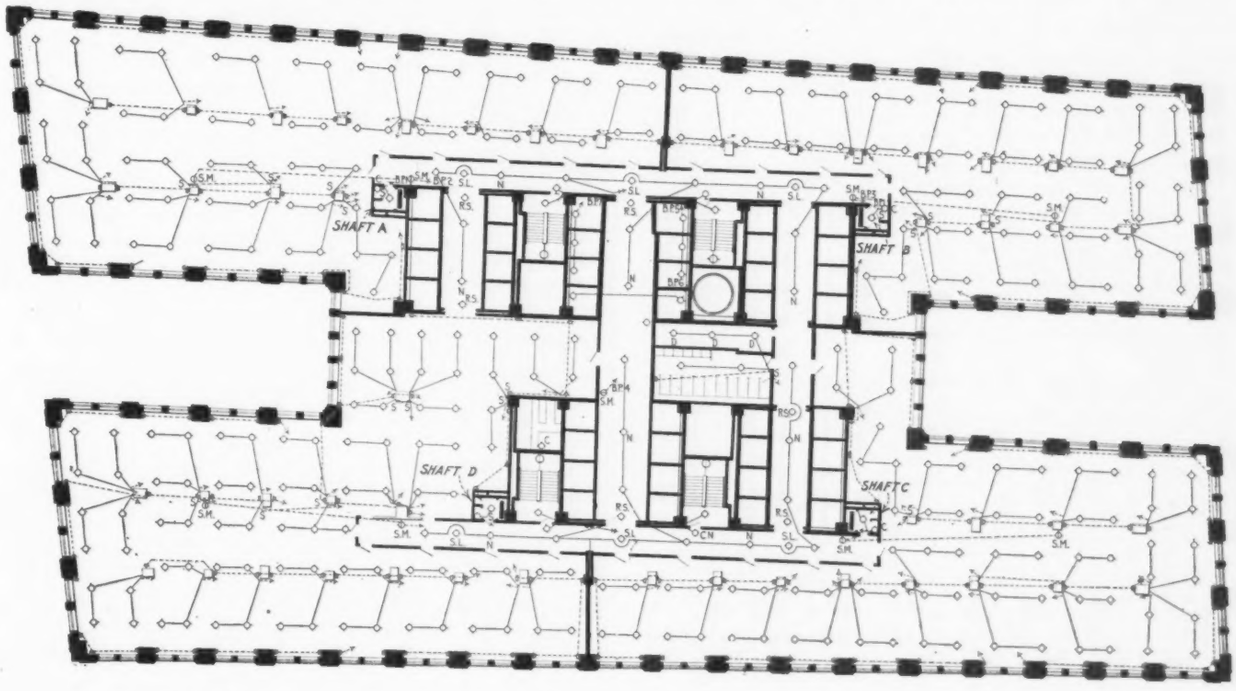


TYPICAL CORRIDOR AND OFFICE FIXTURES WHICH CAN BE EQUIPPED FOR DIRECT OR INDIRECT ILLUMINATION

To provide for carrying about 50,000 persons a day, with a rush load of 3000 persons every fifteen minutes (the estimated traffic), the cars were designed with an average floor space of 37.5 sq. ft. each and equipped with motors capable of propelling them at 550 ft. to 650 ft. per minute, depending on the service. Comparisons of the elevator equipment with that in other large buildings in New York City are given on page 140.

Provisions for Emergency Operation and Stops

A safety arrangement is provided for the elevators of the Equitable Building, permitting the operation of the elevators by gravity in an emergency. For this purpose a small independent supply of energy is provided

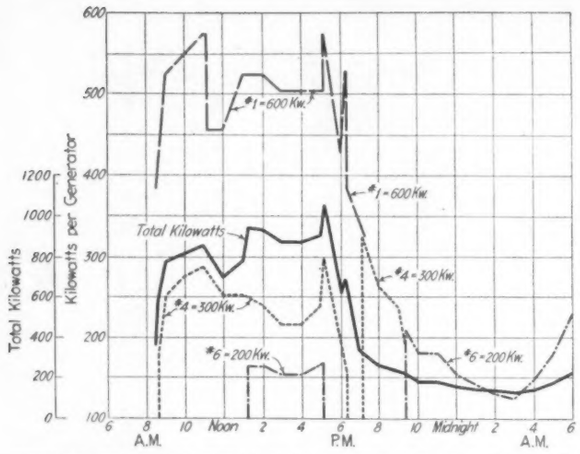


C = Ceiling Outlet
B = Bracket »
R = Base Receptacle Outlet
CS = Clamp Screw Socket
F = Fan Outlet
S = Switch Outlet
SMO = Scrubbing Machine Outlet
GE = Combination Gas and Electric Outlet

NL = Night Light
DC = Drop Cord
IT = Intercommunicating Telephone Outlet
RSO = Room Sign
PT = Public Telephone Outlet
FA = Fire Alarm Outlet
G = Gong Outlet
SLO = Signal Light for Elevators

→ Indicates Run of Circuit to Panel Board
→→ » 2 Circuits
P » Public Light
C » Corridor Light
N » Night »

ARRANGEMENT OF LAMP AND OTHER ELECTRIC-SERVICE OUTLETS ON TYPICAL OFFICE FLOOR



TYPICAL UNIT AND TOTAL LOAD CURVES FOR DEC. 14, 1915

for exciting the shunt field of the elevator motor and energizing the potential and safety switches and brake magnet coil. In an emergency requiring the exit of the occupants of the building after the failure of the regular energy supply the elevator car, empty except for the operator and overbalanced by the heavier counterweight, may be run to the upper floors by the action of gravity. When loaded with passengers, it will descend without electric power by overhauling the counterweight. During emergency operation the elevator motor acts as a generator or dynamic brake, counteracting gravity to an extent governed by the controller.

Each elevator is equipped with an electro-mechanical safety stop which applies a strong mechanical force in case of a free falling car with ropes parted and a light retarding force in case of overspeed with ropes intact.

The following figures show the energy consumption for elevator, motor and lamp service in the month of December, 1915:

	Kw.-hr.	Percentage of Total Consumption
General lighting	15,205	10.9
Generating station lighting	10,241	7.3
Elevator	71,681	51.1
Motor service exclusive of elevators	43,070	30.7
Total	140,197	100.0

Distinctive illuminated letter signs for indicating office location, elevators, etc., are employed on each of the office floors. Those designating office location are situated where they can be seen immediately on stepping off the elevator, being placed at both ends of the elevator corridors and bearing the numbers of the offices which can be reached from their respective ends of the corridor. Signs indicating local or express elevators are hung from the ceiling opposite the corresponding elevator shafts.

On the main floor at the ends of each cross passage are triangular-shaped elevator signs which can be read from either end of the corridor by which the elevator passageway is approached. These indicate whether the elevators on a particular corridor are express or local and what floors they serve.

All tenants' telephones are served by direct lines from the New York Telephone Company's nearby exchange instead of by central operators inside the building. Telephones belonging to the Equitable Office Building Corporation, however, of which there are about 200, are served from a local switchboard on the fourth floor.

On each floor of the building is a combined fire-alarm and night-watchman signaling box which is connected with the National District Telegraph Company's main office. Should it so happen that a fire alarm is "turned in" at the same time that a watchman is sending his signal, the fire-alarm signal will take precedence over the other.

The Equitable Building was designed by E. R. Graham, architect, Chicago, and constructed by the Thompson-Starrett Company, New York City, Henry C. Meyer, Jr., being consulting engineer for the Equitable Society and Charles E. Knox engineer on elevators. H. J. Davison, New York, was decorator for the Bankers' Club.

GROUPING OF ELEVATORS AND SERVICE PERFORMED BY EACH

Group	No. of Cars	Service	Floors Served	Car Speed, Ft./Min.	Type of Drive
1	8	Local	1–12	550	Gearless 1:1 traction
2	8	Combined express and local service	1–11 express 11–18 local	650 550	Gearless 1:1 traction
3	8	Combined express and local service	1–19 express 19–24 local	650 550	Gearless 1:1 traction
4	8	Combined express and local service	1–25 express 25–30 local	650 550	Gearless 1:1 traction
5	8	Combined express and local service	1–31 express 31–36 local	650 550	Gearless 1:1 traction
6	8	Local for intercommunication	1–37	550	Gearless 1:1 traction
7	3	Equitable Co. private car	Sub-basement-9	450	Gearless 2:1, rope-geared drive
		Public Safe Co.	Sub-basement-1	150	Worm-geared traction
		Empire Trust Co. private car	Sub-basement-3	250	Worm-geared traction
		Sidewalk plunger elevator	Boiler room-1	125 50	Hydraulic

Three and a quarter miles of vertical rails and 92 miles of cables (six per car), including that for counterbalancing, are employed for the elevator equipment.

COMPARISONS OF EQUITABLE BUILDING ELEVATOR EQUIPMENT WITH THAT IN OTHER NEW YORK BUILDINGS*

Name of Building	Number of Gearless Traction Elevators per Building	HP. RATING OF MOTOR		LOAD IN POUNDS CAPACITY OF ELEVATOR		Nominal Car Speed in Ft. per Min.	RISE OR TRAVEL OF CAR IN FT.		Average Floor Heights in Ft.	CAR AREA IN SQ. FT.		Approx. Rentable Floor Area of Building in Sq. Ft.
		Average	Total per Building	Maximum Passenger	Safe Lift		Maximum	Total per Building		Average	Total per Building	
Equitable	48	36.5	1,752	2,500–3,600	7,000	550–650	547	16,532	13.0	37.5	1,800	1,200,000
Hudson Terminal	39	33	1,287	2,500–3,000	8,000	500–600	285	7,785	12.4	37.4	1,458	915,000
Whitehall	29	35	1,015	2,500–3,000	8,000	500–600	383	7,237	12.0	35.2	1,021	550,000
Woolworth	26	39	1,014	2,500–4,000	6,000	550–700	680	10,041	13.7	31.5	819	600,000
Adams Express	24	32	768	2,500–3,000	8,000	550–600	420	7,968	13.1	39.2	940	460,000
Western Union	20	35	700	2,500–3,000	6,000	550–600	376	5,590	13.4	35.6	712	364,000
Fifth Avenue	19	35	665	2,500	8,000	600	184	3,405	13.1	34.1	647	464,000
Altman	18	40	720	2,000–4,200	....	450	195	3,067	16.2	45.9	826	.....
Singer	15	35	525	2,500	5,000	600	547	4,023	13.3	35.7	535	335,000
N. Y. Telephone	14	46	644	3,300–3,600	5,000	600	271	3,549	15.0	43.6	610	217,800

*Data furnished by David Lindquist, chief engineer Otis Elevator Company.

The Young Electrical Engineer's Opportunities

Next June about 1600 *young men, in round numbers, will be graduated in electrical engineering. From now to that time each of these men will be considering what is to be his life work. The article that follows is the first of a series in which opportunities for electrical engineers in the various branches of the industry and the allied arts will be presented.*

MOST of us get into our life work by accident rather than by design. Work is an evolution. So at the start of this series of articles it may be well to say that there are very few of us who may so plan our lives in detail that we may determine what we will be doing ten, fifteen or twenty-five years from now. When such a plan exists its owner is apt to be accused of being too perfect for this world, and, as they sometimes put it on the New England peninsula, "The boy is too good to live." Yet when we have taken the step of choosing our profession and determined that we will be engineers rather than doctors or preachers or patients or parishioners, it seems worth while to analyze the scope for our activities and to estimate the measure of service which we can render in each of the fields that lie open to us.

The first step in making this analysis is to try to separate specific training from capacity and inclination. One engineer with whom this series of articles was discussed said: "I always compare men on my staff with the guns in my cabinet at home. Some men are twenty-two-caliber men, and no amount of training will increase their gage. Others are elephant guns, with brains that will bring down the biggest game. We cannot assume that men are all 'elephant-gun' men or can be trained to become large-gaged. On the other hand, we need twenty-two-caliber men. Nor does this mean that the small-gaged man is a pop-gun. On the contrary, I have a gun of 0.22-in. caliber which will bore a hole in a steel plate 3 miles away. I have a man in my organization who is this kind of a twenty-two-caliber-man. He will never think in big units, but he is drawing a salary out of proportion to his gage because he 'carries' in a detail situation."

Differing Degrees of Capacity

Degrees of capacity and degrees of responsibility are found in all groups of individuals, whether they call themselves engineers or doctors or business men. Capacity is a factor in opportunity we cannot altogether control. Some men at thirty-five have lived fifty years in experience. They are bigger men. Let's admit it and let it go at that. The main point is that we must have enough faith in our fellows, enough imagination, strength of purpose and moral courage not to assume that we are "twenty-two short" when we begin.

Then before we come to technical knowledge there is the question of inclination. Few of us at twenty-two have a philosophy of life or a formula for success. It is fair to say that most of us are finishing life with the same indefiniteness of purpose. Yet a mere cataloging of our inclinations may help set us in the right direction and then turn our knowledge in a special field to the greatest mutual benefit to society, which made that knowledge possible, and to ourselves.

Our industry is an inclusive one. The adjective "electrical" precedes science, engineering and business. As electrical engineers it is possible to classify our natural inclinations under many heads, but it has always seemed to the writer that there are two types of men in the industry, the "business type" and the "laboratory type." Before determining our future work it may be worth while to set down these two headings, list the qualifications under each, mark ourselves on a percentage basis, sum up our columns, and see whether by this rough test of capacity and inclination we are strong one way or the other.

As a matter of observation of a good many successful men the writer ventures to classify the qualities under each of these headings in the following parallel:

Business Type	*Laboratory Type*
Looking for new ideas	Inclined to be intolerant
Great initiative	Works better under a plan
Personally resourceful	Relies on past performance
Discounts the past	Discounts the future
Guesses intuitively	Measures
Creates	Plans
Knows human nature best	Strong sense of physical values
Quickly understands what people want and will pay for	Sees better how to supply the want
Sees in terms of results	Sees in terms of quality
Sees the ends to be obtained	Sees the machinery of accomplishment

In the writer's judgment the leaders in the industry to-morrow will combine these qualities in some degree. They are set down here for their directive value and not for the purpose of stating that one group of qualities is better than the other.

Surveying the Field as a Whole

Having determined, or at least considered, his inclinations, a young man with mind trained in electrical theory and to some extent in practice stands looking out over this great industry of ours. In the writer's judgment the horizon of the young electrical engineer's opportunities should not be the boundary line of those fields of applied engineering or research which are stamped electrical. This does not mean that a man who is graduated in electrical engineering should become a milkman if he sees a chance to make some money. It does mean that in the industries of mining, for example, steel making, textiles, leather and wood, there are opportunities for constructive electrical invention and application, as well as in the more immediate central-station, railroad, telephone and electrical manufacturing fields. It means also that within the electrical industry itself the young electrical engineer's four years of special education is not lost if he does not become an electrical designer. It means, in short, that the field of electrical engineering is very broad and that in its financial, commercial, engineering and research branches there are opportunities for the men who are coming.

In the articles to follow, these opportunities will be presented in greater detail with tables and charts which it is hoped will help young men to find their places in the industry and assist the men already established in finding young men to help them.

The articles to follow will include a discussion of the electrical engineer's place in the manufacturing fields, in the telephone and telegraph branches, in the electric-railway industry, in the fields of invention and research, and in allied arts and industries. The central-station industry is calling for men not only in the operating and transmission departments but in the commercial, financial and management sides of the business. Many men, too, have entered the profession of patent law, and the government service offers a class of work whose importance has received a new impetus following the emphasis recently given to the engineer and his relation to national defense.

The Design of Power-Station and Substation Bus Structures

Considerations When Laying Out and Installing Switching Apparatus in New and Old Stations—Features of Typical Installations Showing How Space Restrictions Were Overcome

BY M. M. SAMUELS

IN the design of a power house or substation it is necessary in nearly all cases to determine the size of the building, and in many cases even to start construction on building foundations and walls before the type and number of switches is decided upon. The space required for the bus structure must therefore in many cases be estimated. Later on the problem of arranging the necessary switching apparatus in the allotted space presents itself. It is seldom the case that there is too much space for a bus structure, so that it is necessary to figure closely on clearances and thickness of walls. The saving of ¼ in. on the thickness of a barrier will often make it possible to get an additional cell into the structure. The problem is most difficult when it becomes necessary to install new switch gear in old buildings or add new cells for a different type of switch in an old structure. It is therefore futile to attempt to suggest any sort of standard arrangement for bus structures. However, the accompanying illustrations may help in many cases to estimate space requirements, and in some cases suggest designs with the necessary modifications for individual requirements.

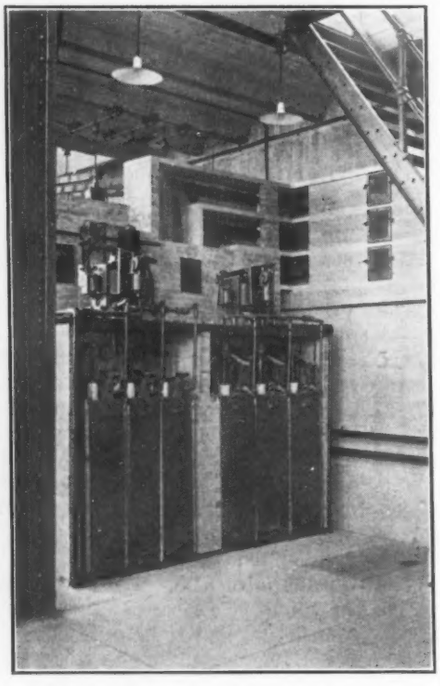


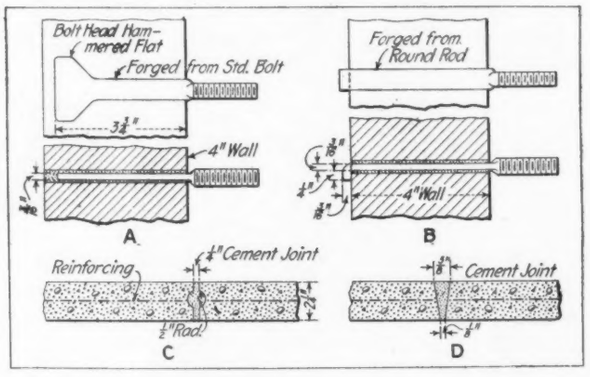
FIG. 1—BUS STRUCTURE SHOWN IN FIGS. 10, 11 AND 12

DESIGN OF BRICK COMPARTMENTS

The question of concrete versus brick construction has been frequently discussed, and opinions as to which is preferable will always differ. However, at the present time the majority of engineers who design bus structure construction seem to favor brick. Other materials, such as hollow tile and hollow concrete brick with grout poured in later, have been and are now being tried out with varying results. There are two strong arguments in favor of brick—first, the possibility of making changes and installing new switches in an old structure; second, the good appearance of brick.

The general run of bricks used for bus structures measure 4 in. by 8¼ in. by 2¼ in. The walls will therefore be 4 in. or 8¼ in., and in some extreme cases 12½ in., thick, allowing ¼ in. for a joint. Through bolts with washers should be set in the 8¼-in. wall for holding oil switches and other heavy apparatus. However, it will often be found cheaper to drill the walls and use expansion bolts for apparatus of small weight, such as disconnecting switches, insulators, instrument transformers and the like. It is not advisable to drill 4-in. brick walls, as the thin wall will not usually withstand a heavy hammer. It may be considered good practice whenever it is possible to make the vertical spacing of bolts a multiple of 2½ in., so that the bolts can be set in a brick joint. Forged bolts, such as are shown in Fig. 2 (*A* and *B*), can be used for such purposes and have been used in many cases with good results.

When concrete slabs are used it is advisable to make them upon the floor and make sure that they are thoroughly dried before being set. A three-to-one mixture will usually be found satisfactory. The reinforcing depends in many cases on the engineer's taste, and in a good many instances on the material left over from other concrete work. Expanded metal can be recommended, and most slabs should be of brick thickness, or 2¼ in. The slab joints can be made as shown in either Fig. 3 or Fig. 4. Fig. 3 is preferable, but Fig. 4 will probably be found cheaper. Slabs should not be over 4 ft. long.



FIGS. 2, 3 AND 4—METHODS (A AND B) OF SETTING BOLTS IN BRICK JOINTS FOR MOUNTING APPARATUS IN BUS STRUCTURES, AND TWO METHODS (C AND D) OF MAKING A JOINT BETWEEN CONCRETE SLABS

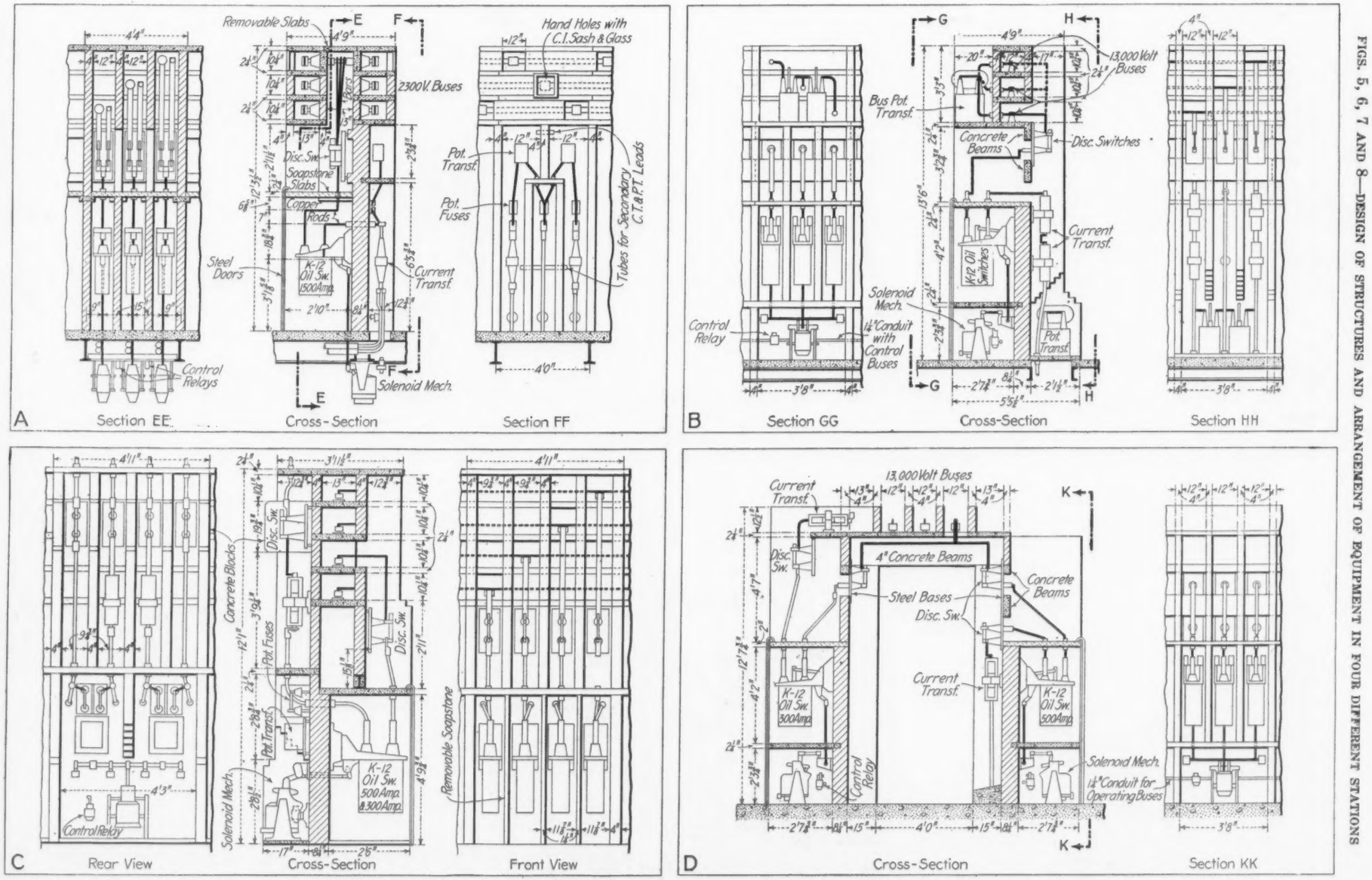
In scheme *C* a round groove is left in the edge of each of two slabs to be joined. The slabs are made ¼ in. shorter than required in order to provide adjustment after they are in place. The space between is filled with cement which works itself into the grooves and makes a tight joint. The form for the second method (*D*) is more simple than that for the first; however, the joint is not so good.

The clearances of Table II can be applied to bus structures as well as to interior wiring.

INSTALLATION OF BUS-STRUCTURE EQUIPMENT

Insulators for supporting buses and other live parts should be as compact as possible, and should be bolted or clamped to the wall or slab. They should not be cemented into the wall or slab, since this construction causes considerable disturbance in operation when it becomes necessary to exchange an insulator. When clamping bus insulators, the clamp should be made in

FIGS. 5, 6, 7 AND 8—DESIGN OF STRUCTURES AND ARRANGEMENT OF EQUIPMENT IN FOUR DIFFERENT STATIONS



(A) Double-bus brick structure in power station of Wilmington & Philadelphia Traction Company. In this case 2300-volt, 800-amp. and 1500-amp. G. E. K-12 oil switches are used. The solenoid mechanism and operating relays are mounted on steel work under the floor. By means of disconnecting switches the oil switches can be thrown to either bus. (B) Brick structure in Augusta (Ga.) substation of Georgia-Carolina Power Company. In this case 13,000-volt, 300-amp. and 500-amp. G. E. K-12 oil switches are used. Between oil switches and buses are disconnecting switches back-connected at one end. The solenoid mechanism is placed in a compartment under the oil switch. (C) Brick bus structure installed in Davenport (Iowa) substation of Tri-City Railway & Light Company. Here 4800-volt, two-phase, 300-amp. and 500-amp. G. E. K-12 switches are used. Disconnecting switches are installed on both sides of oil switches. The solenoid mechanism is installed on the floor in the rear of oil-switch cell. Removable soapstone barriers separate the poles. (D) Double-row brick structure in Columbia (S. C.) substation of Parr Shoals Power Company. In this case 13,000-volt, 300-amp. and 500-amp. G. E. K-12 oil switches are used. A 4-ft. passageway runs between two rows of cells. Common buses are installed over passageway. The slabs under buses are on concrete beams which serve as barriers between phases.

two parts to avoid the necessity of lifting the bus when exchanging an insulator. For bolting down insulator pins, slots can be conveniently provided in the insulator pin instead of bolt holes, as shown in Fig. 13.

Oil-switch cell doors may be made either of asbestos wood or sheet iron, with angle or channel framing. It is advisable to suspend the door from the top without bolts at the bottom so that it can swing out automatically in case of air pressure inside the cell caused by an oil-switch blow-out. In some cases where the cell doors have been bolted considerable damage has been done to structures and apparatus from oil-switch explosions.

Special attention should be paid to the layout of potential transformers, especially when the voltage is above 2300. Potential transformers and potential fuses for higher voltages require considerable space and have to be installed in certain positions, especially oil-cooled transformers and expulsion-type fuses, so that if in the preliminary design these points are not taken into consideration considerable difficulty may be encountered in finding suitable accommodation for them.

In most cases it will be possible to install a positive and negative operating bus at the bus structure, and the control cables from the switchboard to each oil switch may be made up of three conductors, which can be installed in a ¾-in. conduit instead of the five-conductor cables which would be required when no buses are provided at the structure and which need 1¼-in. conduits. The operating buses should be installed in conduits, with outlet boxes at each oil switch. In the structures shown in Figs. 6 and 8 the control buses are installed in one 1¼-in. conduit, which is used at the same time for mounting the operating relays.

When current and potential transformers are installed in separate compartments, holes should be left in the partition walls to accommodate conduits for the secondaries between phases, and in case of potential transformers porcelain tubes should be provided for the primaries. Fiber conduit is being satisfactorily substituted in some cases for porcelain tubes.

The shape and general design of bus structures will generally depend on the following conditions: (1) Type of oil switches, current transformers, potential transformers and disconnecting switches; (2) whether disconnecting switches are installed on one side or both sides of the oil switch; (3) on the amount and direction of the available space—that is, the structure may be

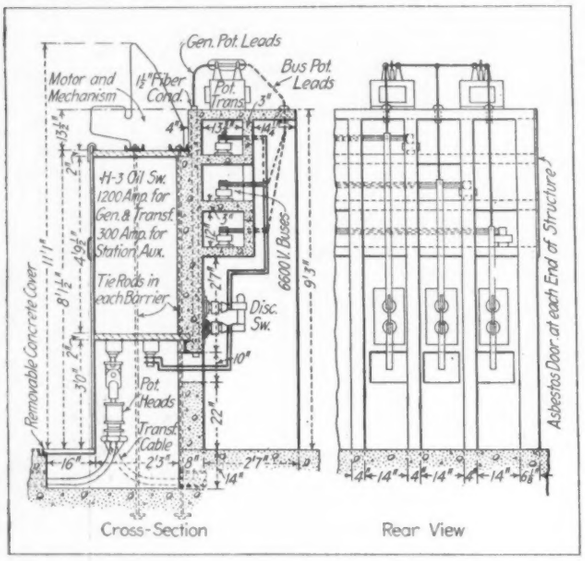


FIG. 9—CONCRETE STRUCTURE IN OCOEE (TENN.) POWER STATION NO. 2 OF TENNESSEE POWER COMPANY

In this installation 6600-volt, 1200-amp. General Electric H3 oil switches are used. Reasons for concrete: (1) Large number of conduits had to be run through main wall; (2) owing to lack of space barriers between poles inside oil switch, cell could not be made more than 3 in. thick. Compartment under oil switch accommodates potheads for 1,500,000-circ. mil cables. A pit is provided for cable pulling.

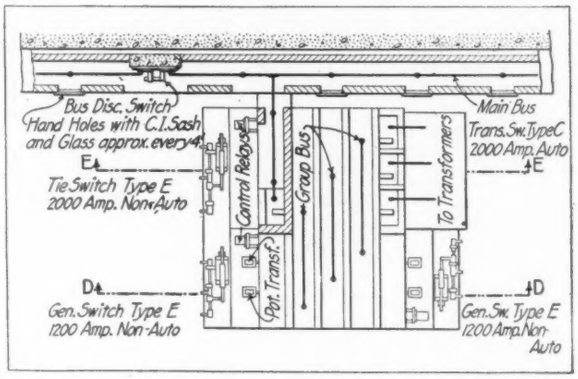
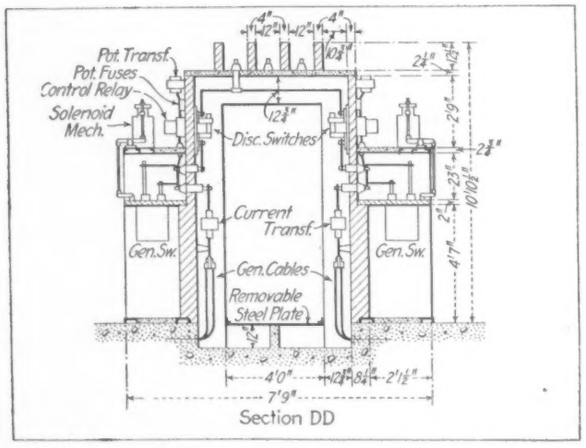
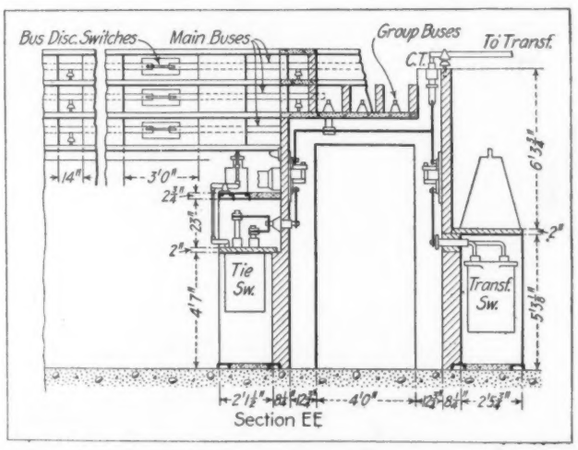

Bus Disc. Switch Hand Holes with C.I. Sash and Glass approx. every 4'
Main Bus
Trans. Sw. Type C 2000 Amp. Auto
Tie Switch Type E 2000 Amp. Non-Auto
Control Reloser
Group Bus
To Transformers
Pot. Transf.
Gen. Switch Type E 1200 Amp. Non-Auto
Gen. Sw. Type E 1200 Amp. Non-Auto

FIG. 11—MAIN AND GROUP BUS ARRANGEMENT IN STRUCTURES AT POWER STATION OF PARR SHOALS (S. C.) POWER COMPANY





FIGS. 10 AND 12—ARRANGEMENT OF EQUIPMENT IN A BRICK STRUCTURE IN POWER STATION OF PARR SHOALS POWER COMPANY. (SEE ALSO FIG. 11)

The structure consists of several blocks of switching and a continuous bus structure which is 205 ft. long. Each block contains two generator switches (1200-amp. non-automatic Westinghouse type E), one transformer switch (200-amp. automatic Westinghouse type C), and one tie switch (2000-amp. non-automatic Westinghouse type E). One generator and tie switch are installed on one side and the other generator and transformer switches on the other side of passageway.

made wide, long or high; (4) whether the cables leave the structure overhead or underground; (5) arrangement of solenoid or motor mechanism. It cannot be impressed too strongly upon the manufacturers of new oil switches to build the solenoid or motor mechanisms so that they can be placed in many different locations in relation to the oil switch. The influence of the flexibility of oil-switch mechanism on bus-structure design can be clearly seen in Figs. 5, 6, 7 and 8.

TABLE I—DATA ON SEVERAL BUS STRUCTURE INSTALLATIONS

Fig. No.	Voltage	No. of Phases	Type of Oil Switch	Location of Mechanism	Width of Cell	Length of of Cell	Height of Structure
5	2,300	Three	G. E. type K12	Under floor	4 ft. 9 in.	4 ft. 10 in.	12 ft. 3½ in.
6	13,000	Three	G. E. type K12	On floor under oil switch	5 ft. 5½ in.	4 ft. 0 in.	13 ft. 6 in.
7	4,800	Four	G. E. type K12	On floor in rear of oil switch	4 ft. 7½ in.	4 ft. 7 in.	12 ft. 1 in.
8	13,000	Three	G. E. type K12	On floor under oil switch	10 ft. 8 in. for two cells and passageway	4 ft 0 in.	12 ft. 7¾ in.
9	6,600	Three	G. E. type H3	On top of cell	5 ft. 6 in.	4 ft. 6 in.	11 ft. 1 in.
10, 11, 12	2,300	Three	West. type E—1200 amp.	On top of cell	7 ft. 9 in. for two cells and passageway	4 ft. 3½ in.	10 ft. 10½ in.
10, 11, 12	2,300	Three	West. types E and C—2000 amp.	On top of cell	8 ft. 1 in. for two cells and passageway	5 ft. 3¾ in.	10 ft. 10½ in.
14	13,000	Three	G. E. type H3	On top of cell	5 ft. 6 in.	4 ft. 6 in.	

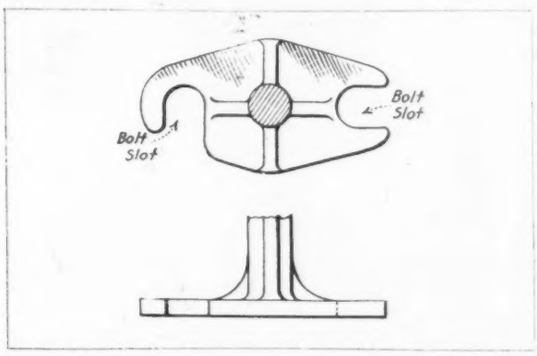


FIG. 13—DESIGN OF INSULATOR PIN FOR BUS SUPPORT. INSULATOR CAN BE REMOVED WITHOUT LIFTING THE BUS

In Fig. 6 the 13,000-volt structure in the Augusta (Ga.) substation described in the Nov. 27 issue of the ELECTRICAL WORLD is shown. The arrangement of solenoids, potential transformers and back-connected disconnecting switches is of interest in this installation.

TABLE II—MINIMUM AND RECOMMENDED CLEARANCES FOR BUS STRUCTURES

Working Voltage	Clearance Between Live Parts, Inches		Clearance to Ground, Inches	
	Minimum	Recommended	Minimum	Recommended
2,300	2½	4	2	3
2,500	4	4½	3	4
15,000	5	6½	3½	5
22,000	7½	9	6	7½
35,000	12	15	10	12
45,000	16	19	14	16
70,000	24	30	21	24
90,000	32	38	27	32
110,000	38	48	33	38
140,000	50	60	42	50

A very complicated 2300-volt structure in shown in Figs. 10 to 13. Three such blocks were installed in the Stevens Creek (Ga.) power station, described in the Nov. 20 issue of the ELECTRICAL WORLD. Four similar blocks were installed in the power house of the Parr Shoals (S. C.) Power Company, in which case the transfer bus is over 200 ft. long.

The apparatus for the structures shown in Figs. 10 to 12 was furnished by the Westinghouse Electric & Manufacturing Company, and that in all other cases by the General Electric Company. All structures shown were designed and installed by the J. G. White Engineering Corporation.

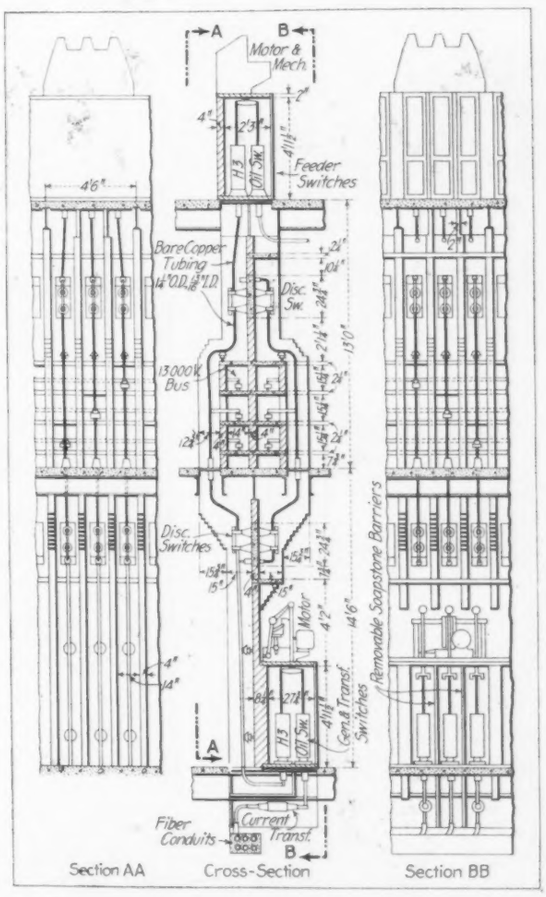
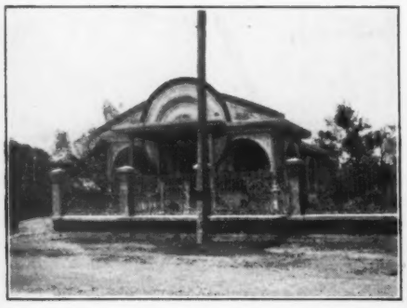


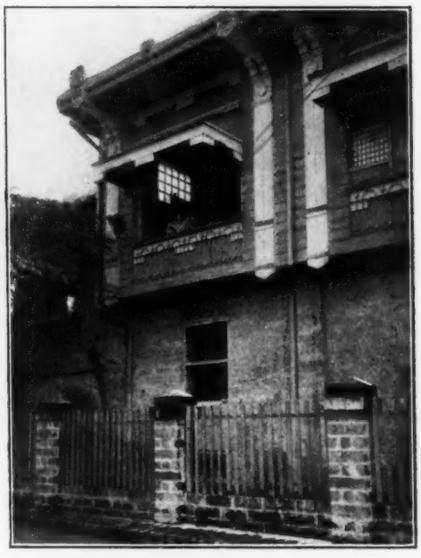
FIG. 14—DOUBLE-BUS THREE-STORY BRICK STRUCTURE IN TERMINAL STATION OF CANADIAN LIGHT & POWER COMPANY

In this case 13,000-volt General Electric H3 oil switches are used. Each oil switch can be connected to each bus by disconnecting switches. Two disconnecting switches and tie bus are mounted on common 4-in. concrete blocks set in the brick wall. Buses are made of bars. Connections are of 1¼-in. outside-diameter copper tubing. Removable soapstone barriers are used as in Fig. 7.

Following the Flag with American Central-Station Methods

How the Manila Electric Railway & Light Company Applies the Principles of Progressive Utility Management to Serving the Native Population of the Capital of the Philippines





At the left is the Manila electric company's exhibit building at a recent native exposition. Above and at the right are pictured typical electric services to some of the curiously ornate homes of the wealthier Filipinos and Spaniards.

MANY OF THE THATCHED BAMBOO HUTS OF THE POORER NATIVE POPULATION OF MANILA ARE LIGHTED BY ELECTRICITY

DEMONSTRATING ELECTRIC APPLIANCES IN THE LANGUAGE OF THE NATIVE CUSTOMER

Applying characteristic American methods to the development of electric service in Manila, P. I., now a city of 350,000 people, the local electric utility company now supplies some 18,000 customers, 6000 of whom are on metered circuits. The company's plant contains 10,000 kw. in steam-driven units. The connected lighting load aggregates 10,000 kw. and the motor load 3500 hp. Nearly 350 kw. is used for municipal street lighting. Following is a census of the equipment connected to the company's lines, as recently compiled by its commercial department: Motors installed, 537; commercial incandescent lamps, 111,298 16-cp. equivalents; commercial arcs, 246; municipal incandescent lamps, 885 60-cp. equivalents; municipal arcs, 470; distributing transformers, 390. The Manila Electric Railway & Light Company is one of the J. G. White properties, C. N. Duffy being general manager at Manila.

Electrical Constants of Compound Antennas

Method for Predetermining the Oscillation Frequency of an Aerial System in Cases Where Capacity and Inductance Are Not Uniformly Distributed

BY A. F. PUCHSTEIN

IN the ELECTRICAL WORLD for Jan. 30 there appeared an editorial calling attention to the desirability of a more general method of calculation for antenna constants than that covered by Louis Cohen's article, "The Electrical Constants of Antennas," in the same issue. The following is the result of an attempt to meet this suggestion. It applies to the case where two antennas, A and B, are connected as shown herewith.

For either antenna part there is a pair of equations of the form

$$\left.\begin{aligned} I &= (A_1 \cos \beta t + A_2 \sin \beta t)(B_1 \cos KS + B_2 \sin KS) \\ V &= \sqrt{\frac{L}{C}}(A_1 \sin \beta t - A_2 \cos \beta t)(B_1 \sin KS - B_2 \cos KS) \end{aligned}\right\} \quad (1)$$

where

$$\beta = \frac{K}{\sqrt{LC}}$$

These apply to all harmonic components of the wave.

For each antenna part (denoted by subscripts a and b) the oscillation frequency of the fundamental component is,

$$\left.\begin{aligned} f_a &= \frac{\beta_a}{2\pi} = \frac{K_a}{2\pi\sqrt{LC}} = \frac{K_a l_a}{2\pi\sqrt{L_a C_a}} \\ f_b &= \frac{\beta_b}{2\pi} = \frac{K_b}{2\pi\sqrt{LC}} = \frac{K_b l_b}{2\pi\sqrt{L_b C_b}} \end{aligned}\right\} \quad (2)$$

When oscillating in unison f_a and f_b are evidently equal, whence we get $\beta_a = \beta_b$, and also,

$$\frac{K_a l_a}{\sqrt{L_a C_a}} = \frac{K_b l_b}{\sqrt{L_b C_b}} \quad (3)$$

The expressions for fundamental wave-length are

$$\lambda_a = \frac{2\pi u\sqrt{L_a C_a}}{K_a l_a}, \text{ and } \lambda_b = \frac{2\pi u\sqrt{L_b C_b}}{K_b l_b}, \text{ respectively.}$$

The final resultant frequency, or the wave-length, is a function of the inductances, capacities and constants K, of which the latter must be determined from the boundary conditions of the problem.

When the antenna system is grounded at one end, say at $S_a = 0$, through a coil having an inductance L_o and negligible resistance, and is open at the other end of the other part, say at $S_b = l_b$, the terminal conditions are the following:

$$\text{At } S_b = l_b,\ I_b = 0.$$

$$\text{At } S_a = 0,\ v_a + L_o \frac{di_a}{dt} = 0.$$

At the junction of A and B where $S_a = l_a$ and $S_b = 0$, $i_a = i_b$ and $v_a + v_b = 0$. Making the proper substitutions in (1),

$$0 = I_b = B_{1b} \cos K_b l_b + B_{2b} \sin K_b l_b. \quad (4)$$

$$0 = v_a + L_o \frac{di_a}{dt} = B_{2a}\sqrt{\frac{L_a}{C_a}} + L_o \beta_a B_{1a} \quad (5)$$

$0 = i_a - i_b$ gives, after time is eliminated,

$$0 = [A_{1a}(B_{1a} \cos K_a l_a + B_{2a} \sin K_a l_a) - A_{1b} B_{1b}]^2 + [A_{2a}(B_{1a} \cos K_a l_a + B_{2a} \sin K_a l_a) - A_{2b} B_{1b}]^2 \quad (6)$$

Similarly, $0 = v_a + v_b$ leads to

$$0 = \left[A_{1a}(B_{1a} \sin K_a l_a - B_{2a} \cos K_a l_a)\sqrt{\frac{L_a}{C_a}} + A_{1b} B_{2b}\sqrt{\frac{L_b}{C_b}}\right]^2 + \left[A_{2a}(B_{1a} \sin K_a l_a - B_{2a} \cos K_a l_a)\sqrt{\frac{L_a}{C_a}} + A_{2b} B_{2b}\sqrt{\frac{L_b}{C_b}}\right]^2 \quad (7)$$

Eliminating the A constants between (6) and (7),

$$\frac{B_{1b}}{B_{1a} \cos K_a l_a + B_{2a} \sin K_a l_a - B_{2b}\sqrt{\frac{L_b}{C_b}}} = \frac{}{(B_{1a} \sin K_a l_a - B_{2a} \cos K_a l_a)\sqrt{\frac{L_a}{C_a}}} \quad (8)$$

Eliminating the B constants with the aid of (4) and (5), we get

$$\cot K_a l_a = \frac{\beta_a L_o\sqrt{\frac{L_b C_a}{C_b L_a}} + \sqrt{\frac{L_a}{C_a}} \tan K_b l_b}{\sqrt{\frac{L_b}{C_b}} - \beta_a L_o \tan K_b l_b} \quad (9)$$

Substituting now

$\frac{K_a l_a}{\sqrt{L_a C_a}}$ for β_a, and $K_a l_a \sqrt{\frac{L_b C_b}{L_a C_a}}$ for $K_b l_b$, we have,

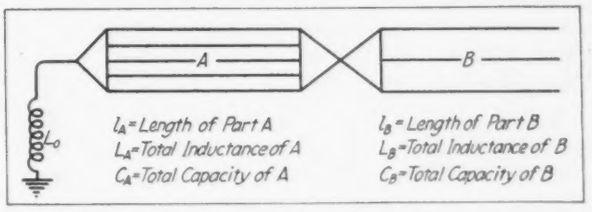
$$\cot K_a l_a = \frac{K_a l_a \frac{L_o}{L_a}\sqrt{\frac{L_b}{C_b}} + \sqrt{\frac{L_a}{C_a}} \tan K_a l_a \sqrt{\frac{L_b C_b}{L_a C_a}}}{\sqrt{\frac{L_b}{C_b}} - \frac{K_a l_a L_o}{\sqrt{L_a C_a}} \tan K_a l_a \sqrt{\frac{L_b C_b}{L_a C_a}}}. \quad (10)$$

This is a transcendental equation which may be solved for any particular case in the same manner as is the simpler equation

$$\cot Kl = Kl \frac{L_o}{L_1},$$

in Mr. Cohen's article referred to above.

When $l_b = 0$ in (9) the formula reduces to Mr. Cohen's result. A more complete, but still partial, check on the


A
B
L_o
l_A = Length of Part A
L_A = Total Inductance of A
C_A = Total Capacity of A
l_B = Length of Part B
L_B = Total Inductance of B
C_B = Total Capacity of B

METHOD OF CONNECTING ANTENNAS IN CASE DISCUSSED

result may be had by noticing that, if correct, it must for a given simple antenna of length l, inductance L_1, and capacity C_1 give the same result for oscillation frequency as does Mr. Cohen's formula.

As an example, we may take the case for which the author has found $Kl = 0.82$ (0.86 is nearer). If we put $L_a = L_b = \frac{L_1}{2}$, $C_a = C_b = \frac{C_1}{2}$, $l_a = l_b = \frac{l}{2}$, and $\frac{L_o}{L_a} = 2$, then f must equal $\frac{Kl}{2\pi\sqrt{L_1 C_1}}$ and also $\frac{K_a l_a}{2\pi\sqrt{\frac{L_1}{2}\cdot\frac{C_1}{2}}}$, and if our formula (9) is correct it must give a value $K_a l_a$ equal to $\frac{0.86}{2} = 0.43$. For this case (10) reduces to $\cot K_a l_a = \frac{K_a l_a \frac{L_o}{L_a} + \tan K_a l_a}{1 - K_a l_a \frac{L_o}{L_a} \tan K_a l_a}$, and we can verify

the identity

$$\cot\left(\frac{0.86}{2}\right)=\frac{0.86+0.459}{1-0.86\times 0.459}.$$

The higher harmonics may be followed out on the principle indicated by Fig. 2 of Mr. Cohen's article. Since the present note is of interest mainly as an extension of the earlier results, the same symbols and general method of attack have been used.

For those who may care to go deeper into the subject, the following outline of procedure is given:

1. *Direct Process.*—With L_a, C_a, L_b, C_b, and L_o known, find $K_a l_a$ from (10) and thence f from (2).

2. *Inverse Process, Case* 1.—With any two of the four quantities L_a, C_a, L_b, C_b unknown, to find the other pair. Use two different loading inductances L_{o_1} and L_{o_2} and note corresponding oscillation frequencies f_1 and f_2. Then set up two pairs of equations of the forms (2) and (10) respectively; $(K_a l_a)_1$ and $(K_a l_a)_2$ will appear as two additional unknowns. All four are necessary for the solution.

3. *Inverse Process, Case* 2.—L_a, C_a, L_b, C_b unknown. Use four different loading inductances L_{o_1}, L_{o_2}, L_{o_3}, and L_{o_4}, and note corresponding oscillation frequencies f_1, f_2, f_3, and f_4. Set up four pairs of equations of the form (2) and (10). There will then be eight equations with eight unknowns.

The unwieldy character of (10) will probably preclude any practical use of the inverse process, but it appears to be of sufficient theoretical interest to warrant its inclusion here.

Status of Water-Power Development*

Economic Advantages of Utilizing Maximum Stream Flow with Auxiliary Steam Stations to Compensate for Water Deficiency

BY H. W. BUCK

Vielé, Blackwell & Buck, Consulting Engineers

IN the beginning of the eighteenth century steam pressure was first applied to the driving of a train of mechanism by a piston and the performance of mechanical work. It was not, however, until about fifty years later that Watt, through extensive original work, had developed the steam engine to a point where it could be considered as available for industrial use. Its application was immediate, and modern industry dates its beginning from that time.

The development of the use of steam-power by Watt and others, and the resulting availability of the steam engine for application in all kinds of industrial work, caused an increase of demand for power at a cumulative rate, and all industry became dependent upon power of a magnitude far beyond the potentialities of human muscles or animal horsepower. The steam engine of that time was, however, very inefficient mechanically and from the standpoint of thermodynamics, and fuels were expensive and not easily available. A search was consequently stimulated among engineers for a method of producing power on a large scale by means more economical than the steam engine.

The energy of falling water was the most obvious alternative, and the engineers of the day devoted their attention to the development of means of utilizing water-power commercially. The early efforts were principally along the lines of the well-known undershot and overshot wheels, now looked upon with considerable humor as relics of more or less prehistoric times.

EARLY COMPETITION BETWEEN WATER-POWER AND STEAM

The contest for supremacy then began between the two classes of prime movers, water and steam, which has continued to this day with increasing vigor, the relative advantage alternating between the one and the other from period to period. The popular notion that water-power is and always has been more advantageous than steam-power is not in accordance with the records of engineering.

In the United States, New England and its vicinity contained many river situations which could easily be developed by the early methods prevailing in water-power engineering, and as a result that section of this country underwent a rapid expansion in industrial development during the nineteenth century, beginning about 1825. The steam engine of that period could not compete with the New England water-powers, and consequently the New England district held a commanding position for many years in industrial progress. Industrial communities grew up around all of the waterfalls of reasonably large volume and moderate head.

The next change in conditions which came about was in favor of steam-power. Economical methods of coal mining were developed, and railroad systems for the distribution of coal grew up, so that coal supplies in volume sufficient for power purposes became available at many new centers of industry. Furthermore, new and radical improvements in steam-engine design were introduced, as exemplified by the relatively large engine units of the Corliss type. Water-powers no longer controlled industry, and industrial centers grew up in Pennsylvania, Ohio and elsewhere where cheap coal of good quality could be obtained in large quantities.

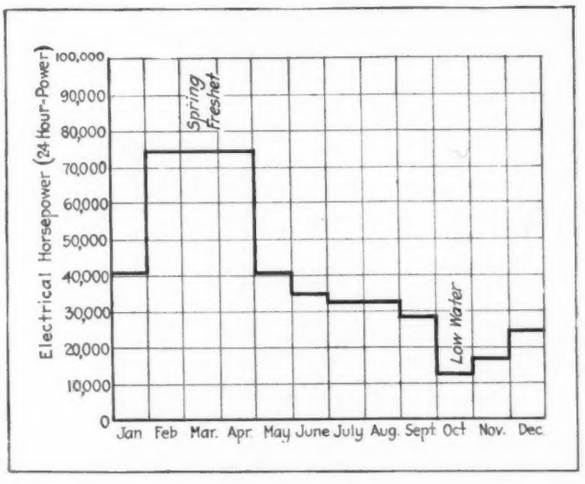


FIG. 1—ANNUAL OUTPUT CURVE FOR 75,000-HP. PLANT (PROPOSED) SITUATED ON RIVER IN SOUTH, WITH SEASONAL VARIATION OF LOAD

About the year 1875 the development of the gas engine as a commercial source of power began as a further competitor of water-power. In large stationary power units, however, the gas engine has been disap-

*Paper presented at Pan-American Scientific Congress, Washington, D. C., Dec. 29, 1915.

pointing and has not proved the universal prime mover which it was at first expected to become. Its field has been confined largely to the smaller units.

The steam engine, the gas engine and the waterwheel then became the three great sources of power, each having advantages under particular conditions. The relative advantages, however, of water-power became less and less as the steam engine and the gas and oil engine were improved.

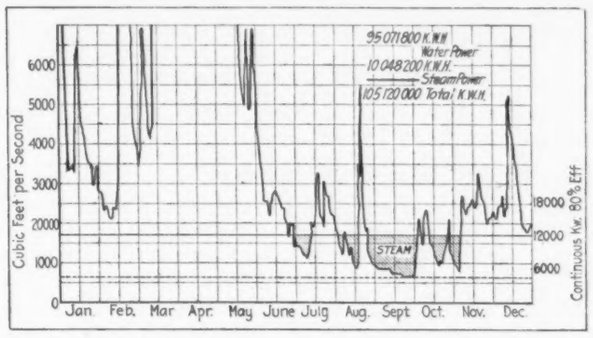

95 071 800 K.W.H. Water Power
10 048 200 K.W.H. Steam Power
105 120 000 Total K.W.H.
STEAM
Cubic Feet per Second
Continuous Kw. 80% Eff.
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIG. 2—HYDROGRAPH FOR REPRESENTATIVE YEAR OF MOHAWK RIVER AT COHOES, N. Y., NET HEAD OF 103 FT.

In the old-fashioned mill town, where the presence of a water-power constituted the reason for the existence of the town, it was necessary, in order that all of the mills might utilize the water-power, to group them close together about some strategic location where a canal or headrace could be favorably constructed. The water from such canal was, as a rule, fed through the various mills, which discharged the water thus supplied through their own individual waterwheels to the lower levels. Sometimes several levels were employed, the water passing in series through the mills from one level to another.

When the water-power development at Niagara Falls was at first proposed, before electric transmission was definitely established, the distribution of water to various manufacturing plants to be established in the vicinity by means of an extensive system of radial canals was seriously considered. Customers were to purchase water and not power from the company and use it to operate their own individual waterwheels. All of the proposed consumers were to discharge their water into a common tailrace tunnel at the lower level.

All of these general schemes of utilizing water-power were inefficient and expensive. Since the headrace canal systems were limited necessarily in extent, the industrial development in a water-power community resulted in a huddled mass of factory buildings, jammed in together as closely as they could be constructed, with the whole zone honeycombed with shafts, tunnels, etc.

In these communities, with the expanding business of the various factories, more power was required than the water system could supply. Consequently, the water-power system was usually outgrown, and it became necessary to supplement the water-power with a steam auxiliary. Such steam plants were enlarged from time to time, and ultimately have become the chief source of power in those communities, with the water-power only as an auxiliary. Many of the old mill towns which are popularly regarded as dependent upon water-power have long since outgrown the underlying water-power and are to-day essentially steam-driven.

HYDROELECTRIC DEVELOPMENT AND ELECTRIC TRANSMISSION

A change and a new era in water-power application began in the year 1892, when power to the extent of 300 hp. was first transmitted on a semi-commercial scale from Lauffen to Frankfort in Germany, a distance of 100 miles, at about 30,000 volts, and the commercial success of high-tension electric transmission was demonstrated. It proved that power could be generated in one place and transmitted efficiently by alternating electric current to points many miles away. At the same time evolution had taken place in alternating-current electric motors, so that the transmitted power could be utilized efficiently at the point of delivery.

This immediately relieved the congestion of the old water-power towns and made it possible to make hydroelectric developments of water-power sites, regardless of any consideration of industrial plants to be located in the immediate neighborhood, and transmit the power output. In other words, the power could be taken to the consumer instead of having to bring the consumer to the power.

Electric transmission from central water-power stations on a large scale began in this country about the year 1895 with the great enterprise at Niagara Falls. In Europe plants of considerable size were built at an earlier date. The voltage limit for transmission at that time was about 10,000, and the transmission distance limit was about 20 miles. Since that time an extraordinary evolution has taken place, so that voltages of transmission are now commercially as high as 150,000 and lines up to 250 miles in length are in operation.

This development and change in methods has opened up an entirely new group of water-powers which were too remote from suitable manufacturing and railroad centers to consider as sites under the old hydraulic scheme of application of water-power. As a rule, water-powers are situated in mountainous regions where the topography is too rough for the satisfactory layout of an industrial town and yet well suited for the construction of a modern hydroelectric plant.

Under this new method of using water-power for industrial purposes its utilization has received a tremendous stimulus. During the past fifteen years many water-powers have been able to show a good margin of saving over the best steam costs, and numerous large central hydroelectric stations have been constructed. The margin of saving in water-power operation since the year 1870 has not, however, been sufficient to prevent a far greater expansion in steam-power for manufacturing purposes than in water-power, and the following table will give an idea of the relative growth of the two as given in the United States Census report:

	Total Steam-Power, Hp.	Total Water-Power, Hp.
1869	1,215,711	1,130,431
1879	2,185,458	1,225,379
1889	4,581,305	1,255,045
1899	8,139,579	1,454,112
1904	10,825,348	1,641,949
1909	14,199,339	1,807,439

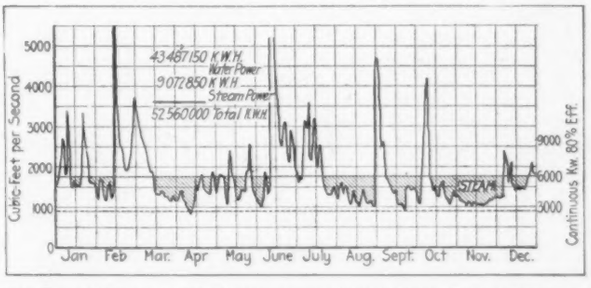

43 487 150 K.W.H. Water Power
9 072 850 K.W.H. Steam Power
52 560 000 Total K.W.H.
STEAM
Cubic Feet per Second
Continuous Kw. 80% Eff.
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

FIG. 3—TYPICAL HYDROGRAPH OF NEW RIVER NEAR FRIES, VA., HEAD OF 50 FT.

The above figures do not include the large central stations generating power by either steam or water-power. Including these, it is estimated that the total water-power developed at the present time is about 6,000,000 hp. and the total steam-power about 27,000,000 hp.

ADVENT OF STEAM TURBINE

The modern development of the commercial steam turbine dates from about the year 1900. This has accomplished for the extension of steam-power use as much as electric transmission has done for water-power.

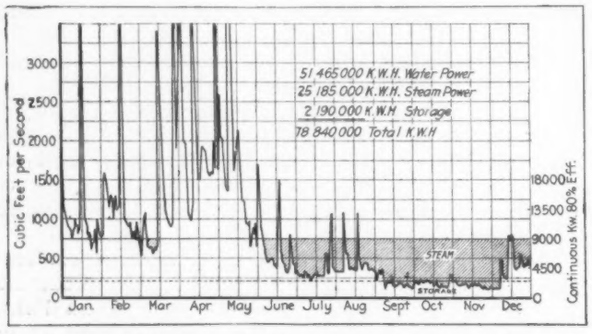

51 465 000 K.W.H. Water Power
25 185 000 K.W.H. Steam Power
2 190 000 K.W.H Storage
78 840 000 Total K.W.H
Cubic Feet per Second
Continuous Kw 80% Eff.
STEAM
STORAGE
Jan. Feb Mar Apr May June July Aug Sept Oct Nov Dec

FIG. 4—HYDROGRAPH OF HOOSICK RIVER AT SCHAGHTICOKE AND JOHNSONVILLE, N. Y., COMBINED HEAD OF 175 FT.

The evolution has been rapid and is still continuing. During the past fifteen years it has resulted in reducing the capital cost of central steam-power houses from more than $100 per horsepower to about $40 per horsepower, and has reduced the consumption of coal from 3 lb. to 4 lb. per kilowatt-hour down to a coal rate of about 1.5 lb. under favorable conditions at the present time. The steam turbine has so much reduced the size and complexity of the steam plant that the operating expense and maintenance are much lower than before.

All of this has caused a serious setback to the expansion of water-power development. It has brought about conditions that make it now usually a serious question, where an average water-power is under consideration, whether the water-power can produce the power as cheaply as the modern steam plant. Water-powers are often situated many miles from the community where the power is wanted for use, which necessitates the transmitting of the water-generated power over a long line. Such electric transmission not only operates to increase the cost of construction of the water-power plant as a whole, and consequently the fixed charges against the power, but also increases the operating expense in line patrol and maintenance. Furthermore, not less than 15 per cent of the power is usually lost in the long-distance transmission, which raises the cost proportionately at the point of delivery.

Where a steam turbine is the prime mover it can in most cases be installed at or near the consumer's premises. This may give the steam plant the controlling advantage.

COST OF GENERATING SYSTEMS

A water-power transmission system of average merit may range in cost at the present time, including transmission, from $150 to $300 per horsepower of rating. A steam-turbine plant, if it can be established at the center of use where a long transmission will not be required, and if of fairly large size, will not cost over $50 per horsepower. The capital charges, therefore, in favor of the steam plant will be in the ratio of from three to six to one. The water-power plant must therefore have a low annual operating and transmission expense in order to overcome the financial advantage of the steam plant.

There are, of course, a few water-powers in the United States and Canada, such as Niagara Falls, Shawinigan Falls and others which have been developed, that can produce power at an exceptionally low cost, with which steam cannot possibly compete. It is such plants that have led to the remarkable growth of the electrochemical industry, which cannot operate except at the extremely low energy cost of from 2 mills to 3 mills per kilowatt-hour.

There are very few water-power sites, however, on this continent which could afford to sell energy for such low rates where continuous twenty-four-hour power is required at a constant rate throughout the year. The only possible way to obtain low kilowatt-hour cost for electrochemical processes from most of our rivers is to develop the water-power for the maximum flow of the stream for, say, three months of the year, and then operate for the rest of the year at reduced output.

ECONOMIC UTILIZATION OF STREAM FLOW

Fig. 1 illustrates such a use of power from a proposed site on a large river in the East, operating on about a 65-ft. head, for an average year of flow. The flow in the river is such that if the plant were rated only on the minimum flow its output would be only a little over 10,000 hp. By developing, however, for the three months' maximum flow an output of 75,000 hp. can be obtained for those months and a reduced rate for the rest of the year.

The cost of a dam is proportional to its length and height, and it does not vary materially with the capacity of the power plant built in connection with it. Furthermore, it does not cost much more to operate at a given locality a plant of large capacity than a small one. Therefore, if a large annual kilowatt-hour output can be secured the fixed expenses can be prorated over a larger total and the unit energy cost be much reduced. The annual output shown in Fig. 1 amounts to 264,000,000 kw.-hr. If the stream were to be developed for the minimum flow only, the annual output would be 65,000,000 kw.-hr.

It is probable that the electrochemical industries could adapt their process of operation to such monthly variations in power delivery without material inconvenience and certainly with great reduction in cost of energy.

Such a scheme of power supply as shown in Fig. 1 would not, of course, be applicable to an ordinary manufacturing establishment, where constant production throughout the year is required, but as a rule there is not the extreme necessity in such cases for power at low cost. In an electrochemical process the power item is generally a large part of the total cost of manufacture.

Within the range of feasible development at a cost of construction which would make the cost of such power about equal to that of steam-power, it is estimated that there is still undeveloped in the streams of the United States about 35,000,000 hp.

It is a popular misconception that, owing to a diminishing coal supply, the cost of steam-power is constantly rising, so that water-powers are becoming more and more in control of the power situation. The fact is exactly the reverse. Methods of deriving the energy of the coal are constantly improving in efficiency, and

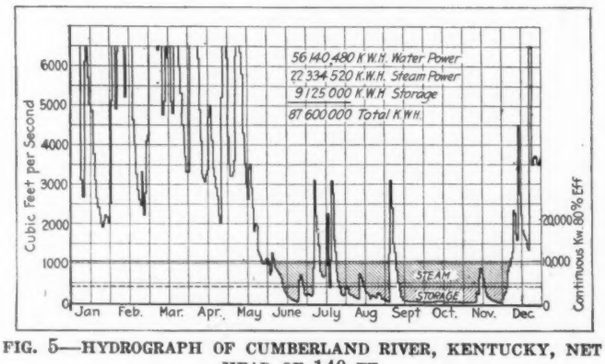
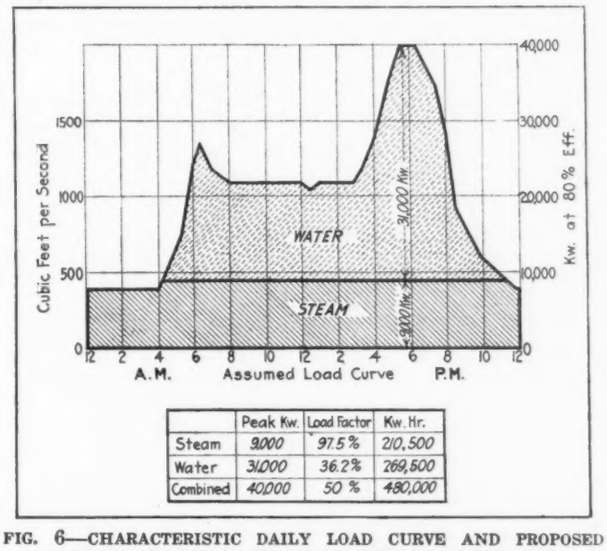

56 140 480 K.W.H. Water Power
22 334 520 K.W.H. Steam Power
9 125 000 K.W.H Storage
87 600 000 Total K.W.H.
Cubic Feet per Second
Continuous Kw 80% Eff
STEAM
STORAGE
Jan Feb. Mar. Apr. May June July Aug Sept Oct. Nov. Dec

FIG. 5—HYDROGRAPH OF CUMBERLAND RIVER, KENTUCKY, NET HEAD OF 140 FT.

even if the cost of coal should rise it would in all probability be more than offset by the increased economy of use. There is nothing to indicate that the limit to the reduction in cost of steam-power has been reached or is in sight, inasmuch as the best type of steam-electric plants to-day utilize only about 20 per cent of the total energy of the coal. Water-power plants are at present, however, about as efficient as can be hoped for, with 93 per cent efficiency for water turbines and 98 per cent for electric generators.

As the cost of steam-power falls, the total water-power of the country susceptible of profitable commercial development continually shrinks, and many water-powers which a few years ago could have successfully competed with steam plants and might have been developed will not be developed to-day on account of steam-turbine competition. The proposed taxation of water-powers and other legislative restrictions will increase the list of water-powers that cannot be developed with a profit.

Even California and other Western States, where a few years ago the high price of coal gave water-power a practical monopoly in the power field, no longer hold



	Peak Kw.	Load Factor	Kw. Hr.
Steam	9,000	97.5 %	210,500
Water	31,000	36.2%	269,500
Combined	40,000	50 %	480,000

FIG. 6—CHARACTERISTIC DAILY LOAD CURVE AND PROPOSED DIVISION OF LOAD OF PLANT ON NIPPASHI RIVER NEAR TOKYO, JAPAN, HEAD OF 350 FT.

this position, on account of the development of the local oil fields, which makes fuel available at a cost low enough for successful exploitation of the steam turbine where long transmissions are required from the competing water-power plant and where the hydraulic development is not of exceptionally low cost.

In South America there are apparently numerous water-powers which could be economically developed. The present high cost there of coal and oil should give water-power development a great economic advantage in the South American countries. The same is true of Canada to a great extent, where there are a large number of exceptionally favorable water-power sites and where coal and oil are both relatively high in price.

Where a water-power plant is required to deliver a practically uniform daily load throughout the year, which is generally necessary on a miscellaneous power distribution system, and where seasonable variations in load, as in Fig. 1, are not permissible, the deficiency at low water flow must be made up either by storage of water or by steam. Usually both are required.

Nearly all water-powers are subject to a period of low water for at least two or three months in the year, and in order to utilize the energy available during the high-water months a combination of steam and water-power is necessary and profitable. The two together will be found in most cases to give a lower cost of annual output than either one or the other alone.

Fig. 2 shows a hydrograph for a representative year for the Mohawk River at Cohoes, N. Y., as an example, together with the effect of adding steam-power to the annual output. If the river at this point were to be developed for low flow alone, and this output maintained throughout the year, the rating of the plant would be only 4600 kw. continuous twenty-four-hour power. For outputs at lower load-factors the installed rating would be correspondingly greater. As shown, however, in the curve sheet, this output can be increased to 12,000-kw. continuous twenty-four-hour power by supplying less than 10 per cent of the total annual kilowatt-hours by steam auxiliary.

Fig. 3 illustrates a typical hydrograph on the New River in Virginia, where the capacity of the plant for continuous delivery of power throughout the year by the supply of 17 per cent of auxiliary steam-power in kilowatt-hours is more than doubled.

Fig. 4 illustrates a situation on the Hoosic River, where the low natural flow is so small that no development would be commercially profitable based upon low flow alone if uniform load throughout the year were a requirement. By the addition of stored water as shown and by the supply of about 32 per cent of steam-power in kilowatt-hours the rating of the plant above the low-flow capacity can be increased sevenfold.

Fig. 5 shows a hydrograph of the Cumberland River in Kentucky and the situation with respect to a proposed development at Cumberland Falls. Here the natural flow of the river at low-water season is such that for three or four months in the year practically no output could be delivered from a water-power plant alone. Both storage and steam are required. The available storage would bring the output up to a continuous annual delivery of 4000 kw., and by the addition of about 25 per cent of steam-power in kilowatt-hours to the annual output the rating of the plant can be raised to 10,000 kw.

IMPORTANCE OF STEAM AUXILIARIES

All of the above curves show what an important and necessary part of a water-power development a steam auxiliary is. This steam-generated power can either be secured by operating occasionally the old steam plants of power customers which have been shut down by purchase of power from a water-power company or by constructing new steam-turbine plants as part of the water-power system.

Where steam-power is to be supplied to make up the deficiency in the water-generated power it is important to operate the steam plant, when running, in the most economical way. The lowest labor and fuel cost will be obtained per kilowatt-hour when the steam plant is operating at practically constant load throughout the day. Fig. 6 shows a specific instance which has been figured out for a large combination plant in Japan. The curve shows the characteristic daily load curve and the proposed division of load between the steam and water-power which gives the lowest steam cost. The operating expense and efficiency of a water-power plant is not so dependent upon constant output, so that it can be operated in the combination at a lower load-factor, taking the peaks of the load.

The outlook for the future development of water-powers appears, therefore, to be largely in the line, either of power plants exclusively driven by water-power for seasonable variation in output, as illustrated in Fig. 1, or for constant output developments, where steam storage and water-power are combined, each contributing to the economy of the joint operation.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

High Coal Economy at Conners Creek Station of Detroit Company

Records Covering Six Months Show 1.47 lb. per Kilowatt-hour—Features of Operation and of the Steam-Station Equipment

Records from the Conners Creek station of the Detroit Edison Company covering six months' operation ended November, 1915, show that only 1.47 lb. of coal has been consumed per kilowatt-hour of energy delivered to the 23,000-volt transmission system. The monthly output was 9,000,000 kw.-hr. and the maximum load 20,000 kw., making the monthly load-factor 66 per cent.

This station operates in multiple with the Detroit Edison Company's Delray steam station and outlying water-power plants, the 23,000-volt cables and overhead-transmission lines being linked into a network. At present the Conners Creek station contains four Stirling boilers, each having 23,654 sq. ft. of heating surface and generating steam at 225 lb. pressure and 200 deg. superheat. They are equipped with twenty-six-retort, sloping-grate, underfeed stokers, which feed fuel from opposite ends of the furnaces into combustion chambers 33 ft. high. West Virginia coal is used, the price of which ranges between $2.20 and $2.40 per short ton delivered on tracks. The average heat content per pound of coal fired in the six months was 13,606 B.t.u.

While the station is designed to house six 25,000-kva. turbo-generators, only two units have been installed, pending the completion this winter of additional 23,000-volt cable links between Conners Creek and the general system. So far the economical load has been within the capacity of one of the two turbines, but the day load will presently be raised to 30,000 kw., and by next autumn the economical load will be approximately 45,000 kw.

Ordinarily each of the turbines is supplied with steam by two boilers, but two turbines can be driven at full load by only three boilers, provided that they are operated at 225 per cent of rating. The turbines permit nine stages of expansion and operate at 1200 r.p.m., driving 4800-volt, three-phase, sixty-cycle generators. Surface condensers, each having 32,500 sq. ft. of water-contact surface, are employed. All auxiliaries except boiler-feed pumps are motor-driven. Boiler-feed water is heated in a barometric condenser receiving exhaust steam from a 1000-kw. house-service turbo-generator.

Provision is made for discharging the air which has been used in ventilating the generators into the boiler furnaces, thereby reclaiming energy lost in electrical equipment. While this saving of heat losses is a factor in the coal economy, it cannot be considered the chief cause for the high coal economy, as part of the heat radiated from equipment usually finds its way to the furnaces in nearly every case on account of the air draft produced thereby. Accurate computation of the saving caused by reclamation of heat losses is impossible, because in cool weather part of the generator ventilation is diverted into the engine room to warm it, and because steam coils are employed in the boiler room for the comfort of the men. The latter arrangement is necessary because every effort has been made to prevent radiation losses from boilers and steam pipes.

Electric Heating Used to Rush Completion of Concrete Work

How Small Car Heaters and Lamp Banks Were Used Under Forms to Provide Necessary Heat to Hasten Hardening of Concrete at Freezing Temperatures

In the accompanying illustrations arrangements are shown for the use of small car heaters and banks of electric lights to maintain a hardening temperature during the recent laying of the concrete floor of the State Street viaduct in Chicago. On account of the fact that the working head-room was a minimum and that heavy traffic was impatient to reoccupy the roadway, the results made possible by these heating methods are of interest.

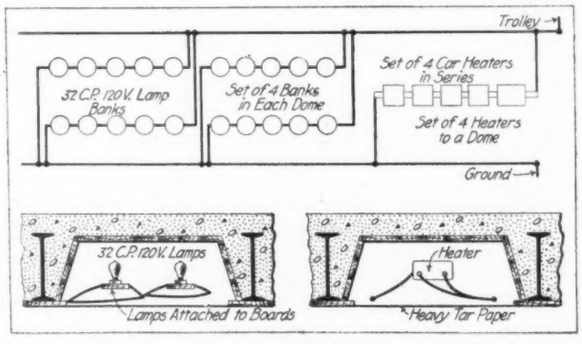

Trolley
32 C.P. 120 V. Lamp Banks
Set of 4 Banks in Each Dome
Set of 4 Car Heaters in Series
Set of 4 Heaters to a Dome
Ground
32 C.P. 120 V. Lamps
Lamps Attached to Boards
Heater
Heavy Tar Paper

FIG. 1—ARRANGEMENTS AND CONNECTIONS OF CAR HEATERS AND LAMP BANKS

During the placing of concrete on the viaduct floor, Dec. 3 and 4, the lowest outdoor temperature was 33 deg. Fahr., with a mean temperature ranging from 34 deg. to 35 deg. On Dec. 5 the temperature dropped to 32 deg., and on Dec. 6 a heating system was required. On the 6th, 7th and 8th the concrete was covered with heavy tar building paper and steam blown under this covering to supply the necessary warmth and moisture to hasten the hardening action. On Dec 10 electric heaters supplied with current from the trolley circuit

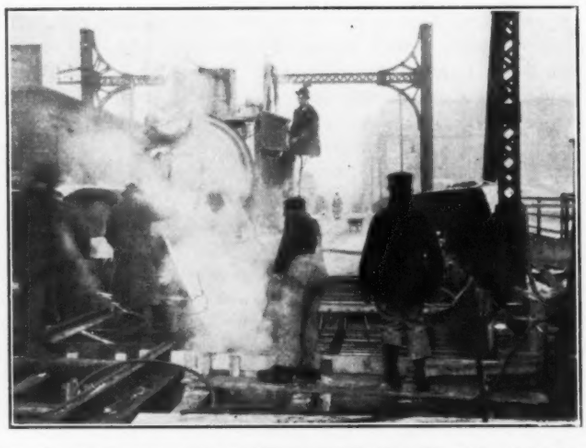


FIG. 2—RECORDING THE TEMPERATURE OF THE HOT CONCRETE AS IT WAS PLACED IN THE FORMS

were placed under the forms and inclosed with tar building paper to retain the heat generated. The fact that there was but a 3-in. clearance between the locomotive smokestacks and the under side of the floor made it impossible to use a heating system for supplying warmth to the concrete that would necessitate consider-

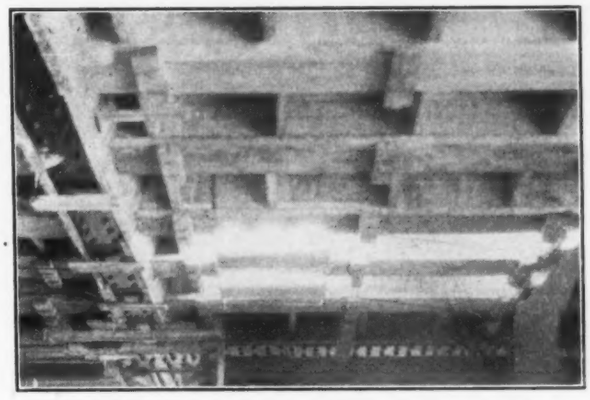


FIG. 3—VIEW OF FORMS FROM BELOW, SHOWING SOME OF THE LIGHT BANKS IN PLACE FOR WARMING CONCRETE

able space for housing. The small car heaters, however, were of such dimensions as not to decrease the head-room. Ten sets of heaters were at first used, but in order to supply additional heat forty lamp banks, each carrying five 32-cp., 120-volt incandescent lamps, were added to the heating equipment. The effect of this addition was very noticeable. The exposed surface of the floor was warm to the touch. A light snow which fell upon it immediately melted, and the consequent moisture evaporated quickly. At this time the temperature of the surrounding air was considerably below freezing.

Although some of the floor was completed before the mean temperature fell below 32 deg. Fahr., the last sections were placed during freezing weather, the last two panels being placed on Dec. 15. It was planned to resume traffic on Dec. 20, so that unusual precautions had to be taken to supply and maintain a warmth that would insure the concrete attaining sufficient strength to be proof against injury from vibrations and deflections caused by street cars in their passage over the bridge.

On the night of Dec. 14 the temperature was 8 deg. above zero, but at 10 a. m. on the 15th it had gone up again to 25 deg. Forms and steel members were in place coated with ice and snow, and it required one hour to melt the ice and warm up the steel with steam supplied through a 2-in. hose. Following this procedure forms were washed with clean, scalding hot water. At 11.15 a. m. Dec. 15 deposition of concrete was begun, the mixing water being heated by steam to 190 deg. Sand and gravel had previously been heated to a temperature of from 140 deg. to 190 deg. Concrete came from the mixer at a temperature of 120 deg. Even after it had been in the forms for fifteen minutes the temperature ranged from 100 deg. to 110 deg. At 11.30 a. m. the temperature of the air was 31 deg., but by 1 p. m. it had dropped to 27 deg. At 1.30 p. m. the concrete that was first placed still had a temperature on the surface of 61 deg. At 3 p. m. the temperature of the air was 30 deg., and as a result of further cooling of aggregates the concrete of the last few batches was placed at a temperature of 70 deg. At 5 p. m. the surface temperature of the concrete was at no place lower than 58 deg. Surface troweling was commenced at 5.30 p. m., and the job was completed, heating apparatus was installed, tarpaulins were spread over the panels and the workmen were on their way home by 9 p. m.

Throughout this work a 1 : 2 : 4 concrete with gravel as coarse aggregate was used. The consistency of the concrete was regulated so that surplus water would be absorbed as far as possible, yet so that the concrete would be sufficiently plastic to settle readily about the I-beams and reinforcing with light spading. The first concrete deposited was of rather wet consistency, but subsequent batches contained less water. A 1-in. thick 1 : 2 mixture of cement-mortar surface finish was used finally, this being simply of moist consistency.

How a Magnetic Clutch Brake Solved a Synchronous-Motor-Drive Problem

BY C. B. FERGUSON

In the plant of the Boston (Mass.) Woven Hose & Rubber Company the rubber mills are driven in groups from a single shaft. In order to improve the power-factor of the system a 650-hp. synchronous motor was proposed for driving this shaft. Two problems were presented—first, providing the safety-stop feature essential with a rubber-mill drive; second, the starting of the synchronous motor. The safety-stop feature is important since the throwing off of the driving power and applying a powerful brake has saved many hands, arms and even lives. In the installation mentioned this feature was provided by use of a Cutler-Hammer magnetic clutch brake installed as shown in Fig. 1. At the same time a gradual acceleration of the synchronous motor under considerable load without pulling it out of step was made possible.

The motor drive and its equipment consist of a 650-hp. synchronous motor mounted on a common sub-base with a rope sheave, the magnetic clutch brake furnishing the connection between the motor and the rope sheave. The motor operates at 240 r.p.m. and under normal conditions carries practically full load when the mill line is in service. Safety switches are installed in the mill room and a slack cable switch in the motor room to stop the motor and line shaft in case the driving rope breaks.

The clutch brake used, or clutch-brake accelerator, as it is sometimes called, consists of a solid circular steel casting mounted on the driving or motor end of the shaft. This member of the clutch carries embedded in its periphery a single cylindrical magnetizing coil, the terminals of which are brought out to an ordinary pair of slip-rings. Mounted concentrically with the coil and the outer periphery is an adjustable friction ring so

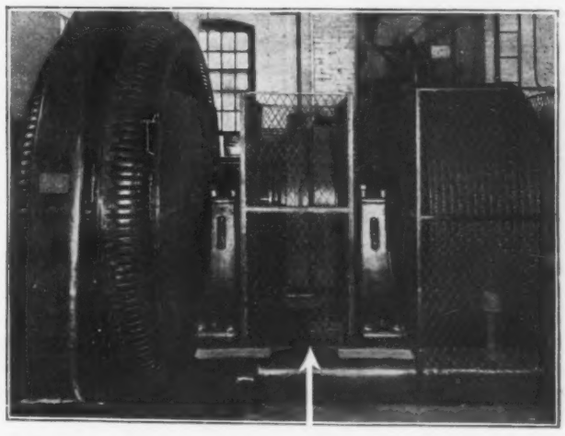


FIG. 1—MAGNETIC CLUTCH BRAKE USED ON 650-HP. SYNCHRONOUS-MOTOR DRIVE IN PLANT OF BOSTON COMPANY

that the metal faces of the driving and driven members do not come directly in contact with each other. This also serves the purpose of providing a permanent air-gap in the magnetic circuit. The other member of the clutch, keyed to the driven or rope pulley side of the shaft, consists of a circular steel armature secured to

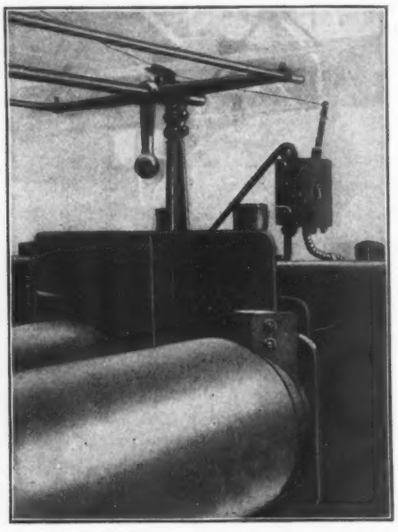


FIG. 2—SAFETY SWITCH TRIPPED BY OPERATION OF ROD SHOWN OVER THE ROLLS; THIS THROWS THE MOTOR CLUTCH OUT AND APPLIES THE BRAKE INSTANTLY

the hub by means of a flat circular spring plate, so that when the magnetizing coil is energized this circular armature is drawn toward the driving member of the clutch, the motion along the shaft being accomplished by a slight dishing of the spring plate upon which it is mounted. This form of clutch possesses the advantage of instant disconnection in case of interruption of the magnetizing current and does not require a portion of a revolution for its disengagement. Also, there is no tendency for it either to release itself or to lock itself because of the mechanical forces exerted as it comes up to speed and while it is running at full speed. Secured to the hub of the driven member is an ordinary brake pulley, over which is carried a band brake of the locking type automatically released by a solenoid mounted on a separate stand in proper relation to the brake beam. The clutch itself is 54 in. in diameter.

The safety switches throughout the mill room are installed and arranged in series electrically so that the clutch will be disengaged and the brake simultaneously applied if a safety bar, one of which is provided for each mill, is tripped. In the motor room there is provided a single push-button for engaging the clutch, the latter being energized by means of an automatic rheostat in such a way as to make it pick up the load gradually and at the same rate of speed for each start. If the clutch is disengaged by the operation of any one of the mill safety stations, the brake is simultaneously applied. If, however, the clutch is disengaged by means of a stopping button on the motor-control panel, the brake is not applied but the load is allowed to coast to rest. The quick stop is therefore obtained only in case of an accident.

Another feature of this control system is that when the safety stations have once been tripped they can be reset immediately, but power cannot be put back on the mill line until the single starting button on the motor-control panel has been operated. A slack-cable switch is also provided so that in case of breakage of the rope drive the clutch is automatically disengaged and the brake applied.

How to Avoid Trouble in Starting an Electrician's Gasoline Torch

BY A. HEARVEY

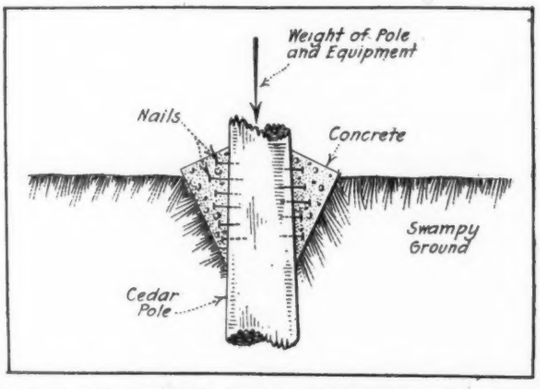
The ordinary gasoline torch is about the most abused tool found in shops and power plants. The first thing a man not familiar with a torch will do when it starts to give trouble is to pump more air into it, which in the majority of cases will not be a remedy.

On several occasions the writer has taken torches from men who were having trouble in keeping them burning and, under the pretext of seeing how much gasoline there was in the tank, has removed the plug in the bottom to let out all of the air. If the tank is full, three or four strokes of the air pump will give plenty of pressure. When lighting a cold torch the proper pressure can be judged by the distance the stream of gasoline will be carried—6 ft. is far enough. After the reservoir of gasoline has been lighted, the valve should be "cracked" a little, so that when the torch is hot enough to vaporize the gasoline it will start at once, giving the characteristic blue flame. By this method a relighting is not needed, as the torch will take care of itself. If there are no leaks in the tank, it will be unnecessary to pump more air into the torch after it is properly started, since the heat which is conducted to the tank from the burner will vaporize the gasoline fast enough to maintain sufficient pressure. The air that is pumped into the torch takes no part in the combustion, as the gasoline is forced from the bottom of the tank to the burner.

If two or more torches are to be used, the work of starting may be lessened by playing the blast of the first one on the burners of the others.

How Poles May Be Kept from Sinking Into Swampy Earth

When poles are set in swamps they may be held in a vertical position by proper guying, but under such conditions something besides guy wires must be used to prevent them from sinking axially into very soft, yielding earth. Poles bearing heavy apparatus or poles under compression due to the line itself are especially liable to sink. This tendency was overcome by the builders of an Ohio transmission line by the scheme shown in the accompanying illustration. At the ground line and

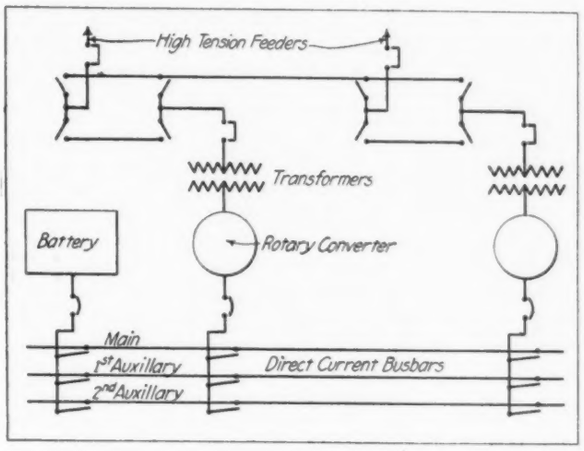


WEDGE-SHAPED CONCRETE COLLAR TO PREVENT POLES SINKING

just below, heavy nails were driven part way into the pole as shown. Around the pole and over these nails a circular, wedge-shaped section of concrete was molded. The nails held the concrete firmly to the pole, and the concrete itself gave sufficient additional bearing surface to prevent further sinking.

Busbars at Different Voltages Energized by Same Standby Battery in Emergencies

A large electric-service company in the West which has been employing reverse-current relays in its direct-current distributing stations has found it necessary to block these relays so that the standby storage battery will maintain practically normal voltage on all the direct-current busbars in case the alternating-current supply to the rotary converters is interrupted. Before this was done interruption of the alternating-current



BATTERY CONNECTIONS TO BUSES OF DIFFERENT VOLTAGES

service caused large voltage drops at some points in the direct-current network. By blocking the reverse-current relays, however, energy from the storage battery is permitted to feed back through the rotary converters connected with it, and thence through the remaining rotary converters to the busbars not directly connected with the storage battery. This permits direct-current energy to be distributed through the normal number of paths instead of through only a few, as would happen if reverse current opened the rotary-converter circuits. This arrangement applies to a station in which there are several direct-current busbars maintained at different pressures to allow for feeder drop. Where all busbars are kept at the same voltage, these provisions are usually not required, since the standby battery may be permanently connected with all of them at the same time.

Detailed Cost of 13,000-Volt Line

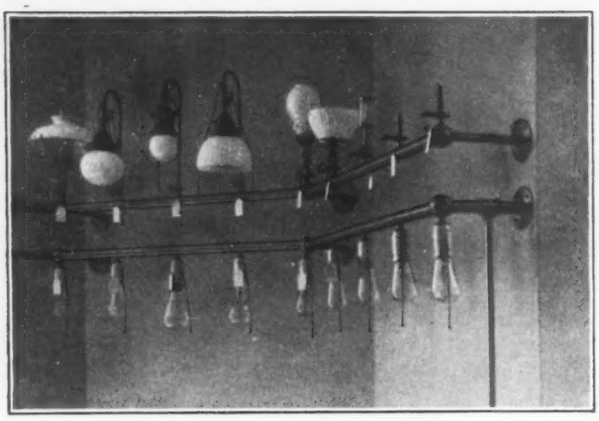
The detailed cost of building a 13,000-volt line 11.6 miles long from Quincy to Brockton, Mass., was recently investigated for the Bay State Street Railway of Boston by Sloan, Huddle, Feustel & Freeman, consulting engineers, Madison, Wis., in connection with an extensive valuation of the entire property of the company. The data were drawn from actual construction cost records in the company's possession, including unit-cost figures. For the above length of line the costs are as tabulated below:

Item	Quantity	Unit Price	Total
Chestnut poles:			
60-ft. grade B	4	$24.45	$98
55-ft. grade B	10	19.10	191
50-ft. grade AA	2	19.02	38
50-ft. grade A	5	16.70	84
50-ft. grade B	8	14.96	120
50-ft. grade C	1	12.62	13
45-ft. grade AA	2	14.10	28
45-ft. grade A	13	11.31	147
45-ft. grade B	30	10.29	309
45-ft. grade C	9	$8.76	$79
45-ft. grade D	1	7.00	7
40-ft. grade AA	1	12.75	13
40-ft. grade A	7	10.65	75
40-ft. grade B	22	9.69	213
40-ft. grade C	29	7.81	226
40-ft. grade D	13	5.88	76
35-ft. grade AA	1	8.86	9
35-ft. grade A	73	6.66	486
35-ft. grade B	297	4.99	1,482
35-ft. grade C	42	4.62	194
30-ft. grade A	7	5.40	38
30-ft. grade B	9	4.44	40
30-ft. grade C	3	3.22	10
25-ft. grade B	1	3.43	3
20-ft. guy stub	5	1.25	6
Cross-arms wood (gallows):			
4-in. by 6-in. by 10-in.	817	1.00	817
4-in. by 6-in. by 7-in.	688	0.86	592
Miscellaneous, including 3¾-in. by 5¾-in. by 12-in., at $1.26	...	....	76
Space blocks, painted, 4-in. by 6-in. by 6½-in.	595	0.084	50
Angle pins, wood	974	0.378	368
Straight-line pins, iron	3,294	0.252	830
Wood bracing, per 1000 bd. ft.	0.325	28.00	9
Cross-arm braces, angle iron, galvanized, 2-ft. by 2-in. by ¼-in.	542	0.63	341
Cross-arm braces, angle iron, galvanized, 2-ft. by 2-in. by 3/16-in.	668	0.49	327
Cross-arm braces, angle iron, galvanized, 2-ft. by 2-in. by ¼-in.	60	0.37	22
Strap-iron, 1½-in. by 5/16-in.	101 ft.	0.084	8
Bolts, galvanized, ⅝-in. by 18-in., machine	754	0.074	56
Bolts, galvanized, ⅝-in. by 14-in., machine	1,798	0.052	93
Bolts, galvanized, ½-in. by 18-in., machine	595	0.05	30
Bolts, galvanized, ½-in. by 7-in., machine	4,888	0.032	156
Bolts, galvanized, ⅝-in. by 4½-in., carriage	8,338	0.014	117
Bolts, galvanized, ½-in. by 4-in., lag.	2,545	0.013	33
Messenger, 5/16-in. strand, guys, per 1000 in.	9.580	8.08	77
Three-bolt clamps	205	0.131	27
Strain insulators	4	0.14	1
Anchors, ⅝-in. by 6-in.	131	0.42	55
Anchors, ⅝-in. by 6-in., T. B.	37	0.79	29
Anchors, ⅝-in. ledge	25	0.37	9
Anchor logs	168	0.52	87
Turnbuckles	12	0.945	11
Pole platforms, wood	2	2.52	5
Timber plank, 2-in. by 8-in., per 1000 bd. ft.	6.5	28.00	182
Wire, aluminum cable, 342,000-circ. mil, main conductors, per 1000 in.	197.168	86.95	17,144
Wire, aluminum cable, 262,000-circ. mil, main conductors, per 1000 in.	152.716	66.53	10,160
Wire, aluminum, No. 1-0 cable, per 1000 in.	3.965	26.78	106
Wire, aluminum, solid No. 2, per 1000 in.	8.6	16.83	145
Wire, aluminum, solid No. 10, per 1000 in.	1.56	2.61	4
Porcelain insulators, angle	974	1.94	1,890
Porcelain insulators, collars	974	0.062	60
Porcelain insulators, straight-line	3,312	0.315	1,043
Erection of line, including clearing right-of-way, teaming, tools, miscellaneous supplies—miles	11.016	$1,728	19,036
Terminal structures	...	....	185
Total construction cost			$58,166
With 11 per cent allowance for engineering, organization, insurance and contingencies and 3.5 per cent for taxes during construction and organization, cost is increased			8,434
Total			$66,600
Land and easements, Quincy and Brockton terminal houses			72,107
Grand total cost			$138,707
Cost per mile of line (two circuits)			1,196

Line contains two three-phase circuits, no ground wire or feeders.

A Pipe Rack for Display of Lighting Fixtures

At the new offices of the Beverly (Mass.) Gas & Electric Company a convenient combination display of lighting fixtures is maintained in the form of a double-pipe rack carrying gas-lighting units at the top



RACK TO SUPPORT LIGHTING FIXTURES

and incandescent lamps at the bottom, as shown in the accompanying illustration. The rack is installed parallel to the walls, which change direction at two points.

The Design of Protective Power Fuses

BY E. A. DILLARD
Assistant Engineer Alabama Power Company

The comment by E. P. Peck in the Dec. 25 issue of the ELECTRICAL WORLD, page 1434, on "The Design and Operation of Horn-Gap Fuses," has made it possible to bring out an interesting comparison between two schemes for obtaining protection to high-tension apparatus by the use of fuses. Mr. Peck raises an objection to the method proposed by the writer in the Dec. 11 issue of the ELECTRICAL WORLD on the ground that in order to obtain the results outlined a fuse must be installed that is much lighter than is consistent with good operating practice. He seems to confuse the time required to melt a fuse wire with the time required by the fuse equipment to clear off the arc resulting from a fuse opening. In the design of high-tension fuses thirty cycles were assumed as the maximum time permissible for the fuse equipment actually to open the circuit. This might be considered as the equivalent time required by an automatic oil switch to open the main circuit after the tripping circuit had been closed. The time required to melt the copper is entirely independent of this and, of course, is dependent only on the current value in the fuse.

For the Alabama Power Company's system a series of computations has been made to determine the actual current values which may be expected with trouble at any point and with any possible feed to this point. If a set of fuses is to be installed to protect a transformer bank, an estimate is made of the current that will actually flow through these fuses in case of a failure in these transformers, and then a size of fuse is selected that will melt at some time before the automatic oil switch at the station or the fuse at the tap-off has had time to operate.

An actual example of this method may be of interest. A 44-kv. feeder runs from a substation approximately 56.5 miles to a 1200-kva. substation at the end of the line. From impedance calculations it was found that 280 amp. would flow in this feeder with a short-circuit at the far transformer bank; also that 150 amp. would flow in the primary line with a short-circuit on the low-tension side of these transformers. The automatic oil switch at the substation from which this feeder runs is set to trip on 200 amp. in two seconds. Hence the fuse installed at the far end of the line must operate in less than two seconds in order to maintain service to the other customers from this feeder. From time-current curves it is found that No. 20 copper wire will melt in one and one-fifth seconds with 280 amp. flowing through it and in five seconds with 150 amp. flowing through it. Since the automatic oil switch will not open on 150 amp., No. 20 wire gives complete protection to the transformers. However, this protection cannot always be obtained, so that it is considered advisable to protect the transformers further with low-tension fuses or automatic switches. Again, it is important to consider the relative importance of service to the different customers that will be affected. For instance, it may be advantageous to use light fuses in small customers' substations that are connected to a feeder serving an important synchronous load so as to guard against losing this load on a heavy "dip" in voltage lasting relatively long.

From the tables submitted by Mr. Peck, the writer infers that he would recommend either a No. 20 or a No. 22 fuse for this installation. Since an exceptionally long feeder is being considered, the value of the short-circuit current at the end of the line is lower than the average value obtained on primary feeders; hence, by using the writer's method, this particular transformer bank should have a lighter fuse than the average bank of the same rating.

Induction Motor Trouble Due to Wrong Stator Connections

By A. C. HEWITT

In a Southern cement plant where a 50-hp., three-phase, 440-volt, sixty-cycle squirrel-cage induction motor operating at 450 r.p.m. was used to drive a 33-in. Fuller mill for pulverizing limestone the motor on several occasions was overloaded by feeding the material to the mill too fast and in large sizes. This overloading, combined with fluctuations of voltage as much as 30 per cent below normal rating, caused the motor to heat and finally called for the replacing of several stator coils. The motor was repaired by the plant electrician and again placed in operation, but still it ran hot, with the mill showing a smaller output than a duplicate installation where the motor was running cooler.

The writer was called to investigate the installation and noticed that the upper half of the motor was much hotter than the lower half. An inspection of the connections seemed to show that they were correctly made and that there were no grounds or open circuits. The fuses were in good condition and the auto-transformer motor starter operated satisfactorily. All of the connections for the starter windings checked with the diagram furnished with the motor.

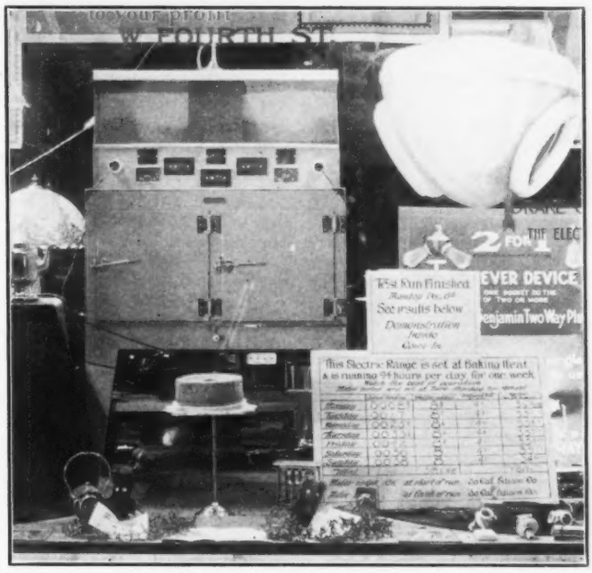
The winding was a two-circuit delta arrangement and the motor had sixteen poles. In checking over the number of poles in each of the two circuits it was finally found that the winding was divided in a horizontal plane through the stator, and that instead of each circuit having eight poles the upper circuit had only seven and the lower had nine poles. This explained why the upper half ran hotter than the lower. The electrician had made a miscount when connecting up the windings, with the result that the load was unevenly distributed. The connections were changed so that each circuit contained an equal number of poles, and the motor operated without the heating trouble previously experienced.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

Demonstrating Electric-Range Economy with a Kilowatt-Hour Meter

With the aid of a kilowatt-hour meter, duly sealed and regularly read by the local electrical authorities, the Drake-Clapp Electric Company of Los Angeles, Cal., made an interesting demonstration of the economy of the automatic electric range shown in the accompanying illustration. The two ovens of this range were started at full baking heat (425 deg. Fahr.) on Monday morning, Nov. 29, and were not cut off until the following Monday morning at 8 o'clock, making a continuous run of seven days, or 168 hours, without variation of the temperature. The electric range used was of the automatic type built by the C. H. Sharp Manufacturing Company of Los Angeles. This range is equipped with thermostatic control, by which the temperature of the oven is held constant. The uniformity of temperature with which the range operated throughout the week is shown by the chart. With electricity at 4.5 cents per kilowatt-hour, the average cost of operating this electric range during the week was only 1.7 cents per hour.


W. FOURTH ST.
Test Run Finished
Set results below
EVER DEVICE
This Electric Range is set at Baking Heat
& is running 24 hours per day, for one week

METER AND CHART SHOWED ENERGY CONSUMPTION DAY BY DAY

Personal Experience and Appliance Sales

The central-station man or dealer who "tries out" electrical conveniences in his own home will often find this a short cut to sales. A liberal policy in lending such apparatus to solicitors specializing along strictly defined lines will pay, and if the apparatus can be kept in service permanently by letting employees have it at the rock-bottom price, so much the better. One instance of what personal experience will do is worth citing.

The head of a certain central-station appliance department used to be obliged to arise in the middle of the night and descend to the pantry in pursuit of milk for an offspring of tender years, the second step in the program consisting of heating said milk on the gas stove, followed by a return to the cribside.

But now behold the results of electrification! A 450-watt electric milk warmer was obtained from the company's office, the bottle of milk inserted and surrounded with cracked ice, and the whole device placed on the window sill, with the twisted cord leading to a chain-pull socket within reach of the bed. Upon the arrival of feeding time it became necessary only to pull the chain and allow energy to flow for four minutes into the appliance. The milk was then ready for use, and without stirring from bed the father of the family transferred the milk to the adjacent youngster, and all was well. The point is, however, that the mere recounting of this experience has resulted in several immediate sales of milk warmers.

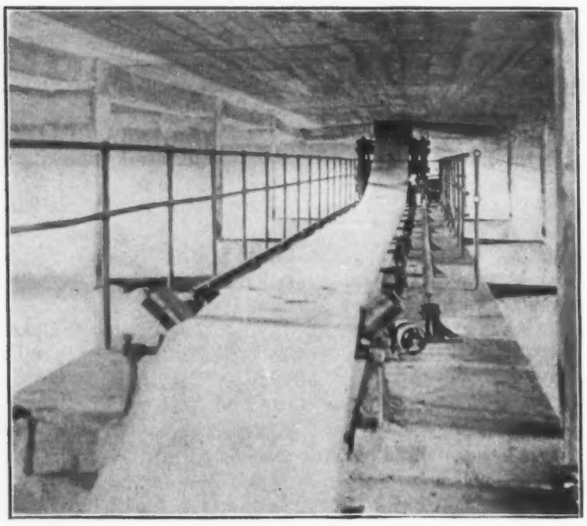
The "Electrical-Page" Idea to Dress a Folder

The Commonwealth Edison Company of Chicago has made a unique application of the "electrical-page" idea by printing a typical display of newspaper articles alongside a forceful advertisement of Edison service for big buildings. The whole was printed as a folder and distributed to a special mailing list. These reading articles were carefully selected to interest and influence the man who is concerned with lighting and providing power for good-sized buildings.

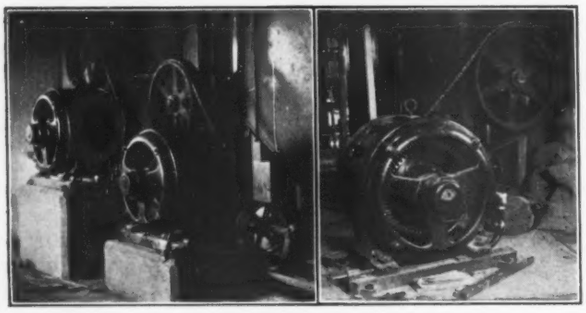
BIG BUSINESS BOOM FOR 1916 IS PREDICTED
GROUP HEATING PLAN MORE WIDE APPROVAL
Continental and Commercial Bank Building uses Edison Service Exclusively
This magnificent structure—home of the largest bank west of New York and the biggest office building in the country—buys all its Electricity for Light and Power from Central Station.
Commonwealth Edison Company
Adams and Clark Streets
The News in a Nutshell
ELECTRICITY SOLVES CITY SMOKE NUISANCE

FOLDER EMBODYING NEWS MATTER WITH DISPLAY ADVERTISING

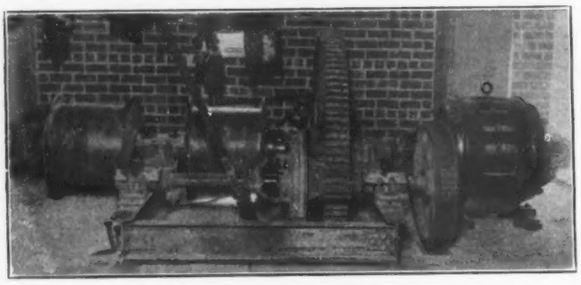
Electrically Equipped Grain Elevator of the Chicago & Alton Railroad at Kansas City, Mo.



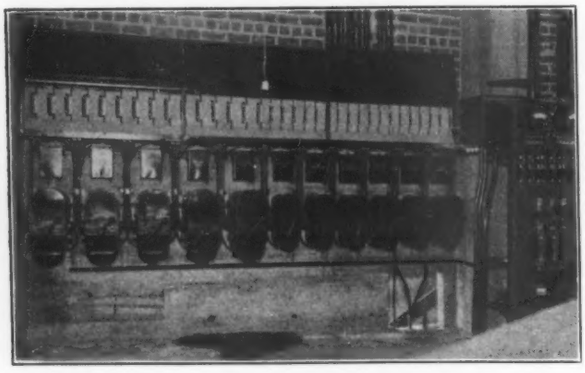
CONVEYOR OVER BINS AND MECHANISM FOR DISCHARGING INTO ANY CONTAINER



AT LEFT—MOTORS CHAIN-CONNECTED TO RECEIVERS AND CLEANER LEGS. AT RIGHT—A 50-HP. MOTOR DRIVING CLIPPER



CAR-PULLER DRIVEN BY 30-HP. MOTOR, USED FOR SHIFTING CARS ON TRACK SIDINGS NEAR THE ELEVATOR

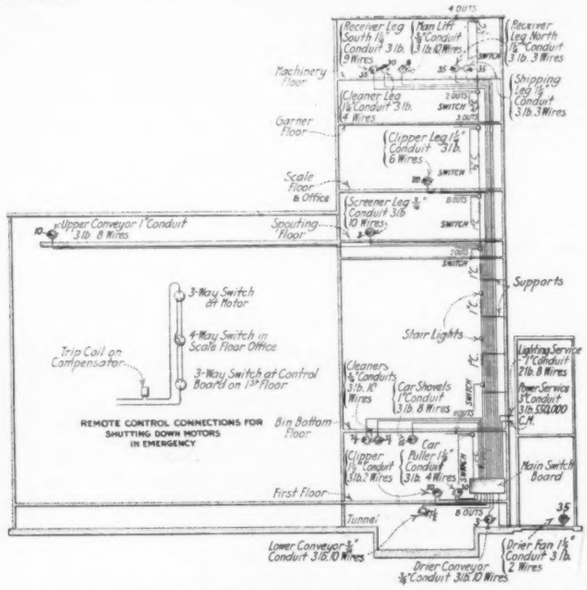


BATTERY OF STARTING COMPENSATORS WITH OVERLOAD RELAYS AND FUSE PANELS, WHICH CONTROL AND PROTECT ALL MOTORS IN THE ELEVATOR

The Chicago & Alton Railroad Company's new elevator is the most recent addition to the electrically operated grain elevators served by the Kansas City Electric Light Company. This elevator is a new concrete building with eight cylindrical bins of 25,000 bushels capacity each and seven smaller bins which bring the storage capacity up to 275,000 bushels. There is a small boiler and drier house separate from the main building, which eliminates all fire of any kind from the elevator proper. In this drier house a 25-hp. motor drives the fans for blowing air through the heating coils and thence up through the grain as the latter is sifted down through the drier. In the elevator proper there are six elevator legs and an upper and lower belt conveyor which serve to carry the grain back to the top and distribute it to various bins as it is newly received from cars. From these it may also be run through the drier or to any of the machines installed in the plant. The latter include a dustless compound "shake" machine which cleans the grain when there is much chaff or tare mixed in with it, a "clipper" machine used to clean up grown wheat, a car puller used to shift the cars on the sidings over the dump pits, and a mechanism for pulling unloading shovels along the car floors. When grain is received or shipped out it is elevated to the garner room at the top of the elevator, whence it flows into the automatic weighing scales on the floor below and thence is spouted either to some bin or to a car for shipment.

The complete motor layout, comprising 326.5 hp., is all controlled from a bank of starting compensators on the ground floor. The motors can be started only from this point, but any motor can be stopped in case of emergency by simply turning one of two snap switches installed respectively beside the motor itself and in the office on the scale floor. This arrangement requires one four-way switch and two three-way switches in each control circuit, any one of which will open the circuit through the low-voltage release coil and restore the compensator handle. All wiring in the plant is carried in conduit.

All motors and compensators are of Allis-Chalmers make, and the motors have dust-proof bearings. The complete motor installation includes four 35-hp. motors on two receiving elevator legs, a 30-hp. motor on the cleaner leg, a 20-hp. motor on the clipper leg, a 15-hp. motor to operate the car shovels, a 10-hp. motor on the upper conveyor belt, and three 7½-hp. motors on the two cleaners and lower conveyor. All of the foregoing machines are squirrel-cage motors with starting compensators and fuse and relay protection. Three 3-hp. motors of the same type, fuse-protected but without starting compensators, operate the screener leg, drier conveyor and man lift. A 30-hp. and a 50-hp. phase-wound motor, with drum-type controllers and fuse and oil-switch protection, operate the car puller and clipper. The electrical installation for the entire plant was laid out and installed by Henry Aberer for the Heidenreich Engineering Company, Kansas City, Mo., designer of the elevator.

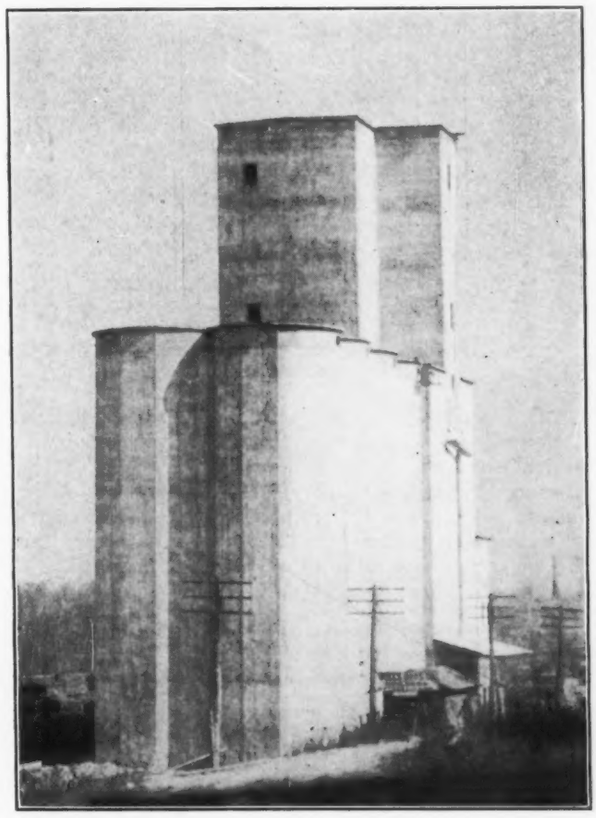

Receiver Leg South 1¼" Conduit 3 lb. 9 Wires
Man Lift ¾" Conduit 3 lb. 10 Wires
Receiver Leg North 1¼" Conduit 3 lb. 3 Wires
Machinery Floor
Shipping Leg 1¼" Conduit 3 lb. 3 Wires
Cleaner Leg 1¼" Conduit 3 lb. 4 Wires
Garner Floor
Clipper Leg 1¼" Conduit 3 lb. 6 Wires
Scale Floor & Office
Screener Leg ¾" Conduit 3 lb. 10 Wires
Upper Conveyor 1" Conduit 3 lb. 8 Wires
Spouting Floor
Supports
3-Way Switch at Motor
4-Way Switch in Scale Floor Office
Stair Lights
Trip Coil on Compensator
3-Way Switch at Control Board on 1st Floor
Lighting Service 1" Conduit 2 lb. 8 Wires
Power Service 1" Conduit 3 lb. 250,000 C.M.
Cleaners ¾" Conduits 3 lb. 10 Wires
Car Shovels 1" Conduit 3 lb. 8 Wires
REMOTE CONTROL CONNECTIONS FOR SHUTTING DOWN MOTORS IN EMERGENCY
Bin Bottom Floor
Clipper 1¼" Conduit 3 lb. 2 Wires
Car Puller 1¼" Conduit 3 lb. 4 Wires
Main Switch Board
First Floor
Tunnel
Lower Conveyor ¾" Conduit 3 lb. 10 Wires
Drier Conveyor ¾" Conduit 3 lb. 10 Wires
Drier Fan 1¼" Conduit 3 lb. 2 Wires

ELEVATION SECTION THROUGH ELEVATOR, SHOWING ARRANGEMENT OF MOTORS AND (IN INSERT) CIRCUITS FOR EMERGENCY STOPS

When Poor Load-Factor Brings Good Business

Electrical Operation of Grain Elevators in Kansas City Has Proved Profitable to Both Central Station and Customer, Despite Limited Number of Hours of Daily Use

It is of much importance in considering the value of prospective power business that the relation of the local load-factor and the local conditions at the station be carefully compared. The experience of the Kansas City Electric Light Company in developing grain-elevator business will illustrate the point. A particular industrial load may exhibit characteristics that seem very undesirable, and yet, as in this case, the burden of demand may fall exclusively at a period in the day



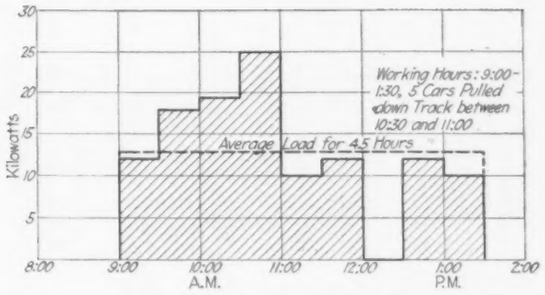
THE CHICAGO & ALTON'S NEW ELECTRICALLY EQUIPPED ELEVATOR AT KANSAS CITY. (SEE DATA AND DETAILS OF MOTOR DRIVE ON PAGE OPPOSITE)

when the station load lies in the valley and every kilowatt-hour of added business is most profitable.

The grain elevator, for instance, owing to the nature of the business, is operated only during a few hours through the middle of the day, a time when the load is most welcome.

A Short-Hour Working Day

The work of the grain elevator is interesting. The grain cars are drilled onto the siding during the night, and in the early morning the few men necessary to the operation of the elevator get things in readiness. Soon after 9 o'clock the machinery is set in motion for the handling of the grain, and the elevating, sorting and cleaning processes are completed in a few hours' time. But the plant must be liberally designed to handle large quantities of grain during shipping seasons, a feature which results in the low load-factor of the plant in the off-seasons when the entire work at hand is turned out in a few hours, and which, naturally, makes the operation of a private power plant exceedingly expensive.



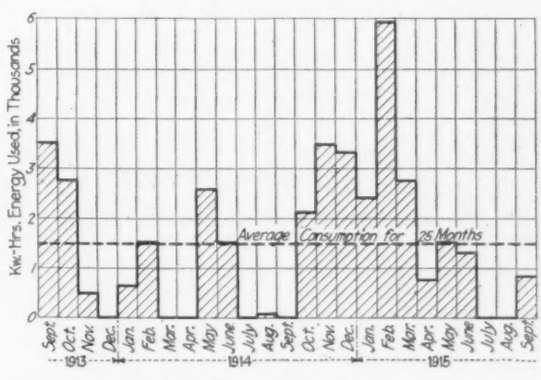
DAILY LOAD CURVE FOR A GRAIN ELEVATOR

The elevator load is bound to be very irregular throughout the year, since it is dependent on so many variables. It will vary with the size of the grain crop each year, with the condition of the grain, and with the trend of the market. If the grain is damp, it must first be dried. This requires frequent handling while the grain is in the elevator, and energy is consumed in "turning" it. If the grain becomes damp while en route in bad weather, it again has to be "turned" frequently. This is done by stopping the car and running it through an elevator—which brings what might be termed transient business to the elevators. Then, again, if the market is poor, the grain will remain in storage longer and have to be "turned" more times, whereby the load-factor of the elevator will be maintained at a better figure. The curve shown below gives an idea of the variation of energy consumption over a period of twenty-five months, during which time it ranges, for the particular plant, from zero to almost 6000 kw.-hr. a month.

Advantages as Central-Station Load

Linked with these peculiar characteristics of the grain elevator load which make it so desirable to the central-station company are the material advantages of electrical operation to the elevator company, and the experience of the Kansas City Electric Light Company has brought out many points that appeal strongly to the grain man. Looking at the subject from this viewpoint, the elevator company gains, as the result of electrical operation, all the advantages of reduced fire risk, ease and flexibility of control of individual parts, reduced space requirements for driving machinery, a cleaner plant, and a decided reduction in operating costs.

On one old elevator in Kansas City the power cost with steam operation was $4.59 per 1000 bushels of grain received, or $2.04 per 1000 bushels of grain in and out. These figures include the cost of coal wages of engineer, firemen and helpers and all straight operating costs without any overhead charges. But when



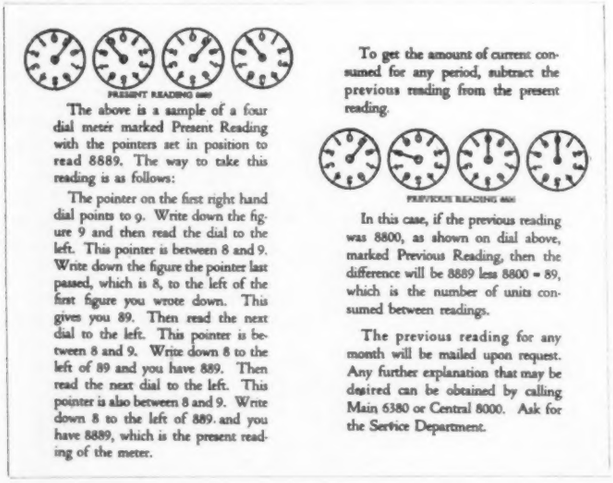
SEASONAL ENERGY CONSUMPTION OF GRAIN ELEVATOR AS SHOWN BY TWO YEARS' OPERATION OF A KANSAS CITY PLANT

the plant was electrified it consumed 42.07 kw.-hr. per 1000 bushels of grain received, 25.5 kw.-hr. per 1000 bushels of grain in and out, or 5.8 kw.-hr. per 1000 bushels of grain handled; and the energy consumed cost $1.72 per 1000 bushels received, $0.97 per 1000 bushels in and out, or $0.23 per 1000 bushels handled. The figures are based on the average for eight months' operation of 1,250,000 bushels a month handled, and they do not show so good an efficiency as would be possible in a new plant. If the fixed charges were included in both cases, however, the comparative figures would be in about the same ratio.

Some of these elevators in Kansas City are old plants in which steam equipment has been discarded in favor of electric power, and some of them were electrified when built, but the character of the load they represent can be seen from the daily load curve. One elevator during a seven months' operating period consumed an average of 2540 kw.-hr. per month with a maximum for any month of 3680 kw.-hr. and a minimum of 1020 kw.-hr. This meant a load-factor for the period of 37.7 per cent based on the thirty-minute demand and eight-hour working day, and figuring this over a full month of 720 hours gives a load-factor of 16.5 per cent. These are low load-factors, but it must be remembered that the load is practically all carried during the middle of the day when a good part of the central station's machines are running at only part load any way, and the elevator load when it comes can be easily carried and improves the station load-factor materially.

Encouraging Customers to Read Their Meters

The Cleveland Electric Illuminating Company has just issued a little booklet the purpose of which is to show its customers how to read their own kilowatt-hour meters. The subject has been treated in simple terms so that it will be easily understood by the general public, and instructions are given for all classes of meters. Four simple rules, applicable to reading any type of



PRESENT READING 8889

The above is a sample of a four dial meter marked Present Reading with the pointers set in position to read 8889. The way to take this reading is as follows:

The pointer on the first right hand dial points to 9. Write down the figure 9 and then read the dial to the left. This pointer is between 8 and 9. Write down the figure the pointer last passed, which is 8, to the left of the first figure you wrote down. This gives you 89. Then read the next dial to the left. This pointer is between 8 and 9. Write down 8 to the left of 89 and you have 889. Then read the next dial to the left. This pointer is also between 8 and 9. Write down 8 to the left of 889 and you have 8889, which is the present reading of the meter.

To get the amount of current consumed for any period, subtract the previous reading from the present reading.

PREVIOUS READING 8800

In this case, if the previous reading was 8800, as shown on dial above, marked Previous Reading, then the difference will be 8889 less 8800 = 89, which is the number of units consumed between readings.

The previous reading for any month will be mailed upon request. Any further explanation that may be desired can be obtained by calling Main 6380 or Central 8000. Ask for the Service Department.

PAGES FROM THE BOOKLET DISTRIBUTED TO CLEVELAND CUSTOMERS ON "HOW TO READ THE METER"

meter, are given as follows in the preface of the booklet:

1. Read the dials from the right to the left.

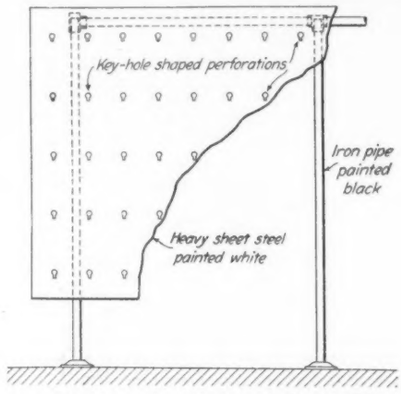
2. The pointers on the dials always turn from the lowest number toward the highest number; that is, from 1 to 9.

3. When the pointers are between any two numbers, always read the smaller number—the number which the pointer last passed.

4. On meters having three or four dials the figures on the right-hand dial represent units or kilowatt-hours. On meters having five dials the figures on the right-hand dial represent tenths of a unit.

An Effective Panel for Displaying Electrical Fittings

Electrical manufacturers and jobbers who wish to display small fittings at conventions are generally at a loss for some easy and striking way of accomplishing this end. The Crouse-Hinds Company, Syracuse, N. Y.,



STEEL PANEL WITH KEYHOLE OPENINGS FOR MOUNTING FITTINGS

solved this problem at a recent Chicago show by using a perforated steel panel mounted on a pipe frame as a vertical support. A short machine screw in the back of each fitting held it in place securely but allowed visitors to remove it for observation by lifting the device slightly upward and then pulling it toward them. The key-hole shape of the perforations punched in the board is shown in the sketch.

Some Large Fleets of Electric Delivery Trucks

Albert J. Marshall, secretary of the Electric Vehicle Association of America, has compiled some interesting figures which show the widespread use of electric trucks and delivery wagons by firms doing a large delivery business.

The American Express Company, for example, has been a consistent buyer of all forms of electric trucks for the past seven years. It now has about 300 "electrics" in use in two cities alone, and the additions to its various fleets during the fall and winter of 1915-16 have been practically all of the electric type. The Adams Express Company operates 326 electrics in two large cities and has just received the final shipment of an increase in one fleet of forty-two electrics. The Ward Baking Company is now using 610 electric delivery wagons. The Jacob Ruppert Brewing Company has 145 electrics, many of which are 5-ton-capacity units, and the George Ehret Brewery has 136. The New York Edison Company has 130. A number of large fleets of electric coal trucks varying from the light 2-ton size to 5-ton and 6-ton trucks are used in and around Boston, where they are operated eighteen hours a day, hauling coal to the business houses and office buildings at night, thus avoiding the difficulty and delay of operating in the sections where traffic is more congested during the day.

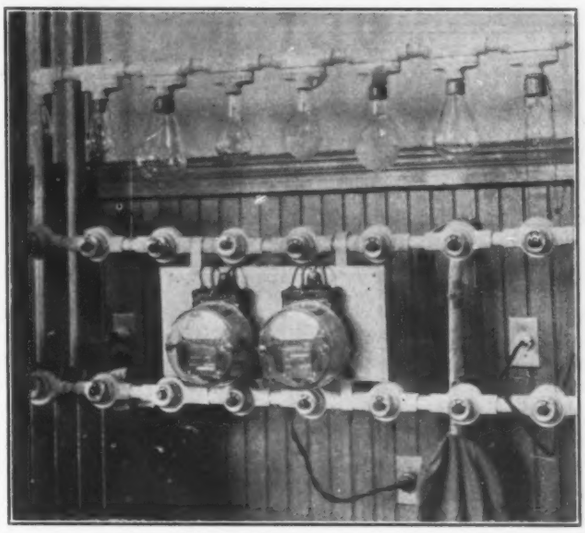
In the lighter class of delivery wagons the department stores have shown a strong preference for the electric

vehicle. Gimbel Brothers operate 119. Lord & Taylor, B. Altman & Company, R. H. Macy & Company, Bonwit-Teller Company, Stern Brothers, Tiffany Company and Franklin Simon Company, all of New York, have adopted electric delivery service. In Chicago the Marshall Field Company operates 230. Woodward & Lathrop of Washington, the Houghton & Dutton Company of Boston and the Bullock Company of Los Angeles are also representative department stores using large fleets of electric vehicles. It is significant, points out Mr. Marshall, that in nearly every case where a concern has adopted the electric vehicle large repeat orders have been the result, evincing a certain confidence in its substantial solidity for city and suburban transportation service.

Electric Fountain Attracted Farmers' Attention to Motor-Driven Pumping Outfits

The Athol Gas & Electric Company was the prime mover in an electric carnival held recently at Orange, Mass., and in connection with one of the local contractors leased a temporary store where an exhibit was made of all kinds of electric devices, appliances and fixtures. As the territory surrounding Orange is one which includes many excellent farms, a special effort was made to have on exhibit as many farm electrical appliances as possible.

To attract attention to the use of electric pumps the electric fountain illustrated herewith was installed in front of the store. This consisted of a motor-driven pump and a 5-ft. galvanized pan measuring about 5 ft. in diameter and 1 ft. deep. Through the center of the pan extended the fountain nozzle, and around the rim of the basin were installed incandescent lamps of various colors. By an arrangement of switches the different colored lamps could be turned on separately or altogether, and the effect of the light from these varicolored units reflected on the water proved the "talk of the town" for some days after the exhibit was removed. Many of the farmers showed great interest in the electric pumping outfits.



EACH SNAP SWITCH CONTROLS THE CORRESPONDING LAMP

Handy Lamp-Display Rack Made Up of Conduit

In the exhibition room of the Cumberland County Power & Light Company of Portland, Me., a handy lamp-display rack of home manufacture is utilized in the comparison of the energy consumption and illumination of different types and sizes of lamps. The rack is built of 1-in. conduit, with condulet fittings, and contains about sixteen lamps ranging from a 2-cp. carbon incandescent to a 300-watt gas-filled lamp. Each lamp is wired to a snap switch below it on the frame, and half the lamps are wired to one of a pair of open-cased meters carried on a 9-in. by 18-in. white-enameled plate of sheet iron held on the horizontal pipe rack by hooks. Each meter is of the 5-amp. size. The rack is 6 ft. 8 in. high, 4 ft. 8 in. wide, and stands 18 in. away from the wall, two 0.75-in. horizontal bracing rods being provided at the ends. The horizontal pipes of the rack proper are spaced from 11 in. to 18 in. apart. Energy is supplied by a flexible cord, plug and wall receptacle.

ELECTRIC FOUNTAIN DEMONSTRATING MOTOR-DRIVEN PUMP, AND TEMPORARY CENTRAL-STATION EXHIBIT AT ORANGE, MASS.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Photometry of Electric Lamps

Determination of the Mean Spherical Candle-power from Measurements of the Candle-power in Two Different Directions for Nitrogen-Filled Tungsten Lamps with Various Filament Arrangements—Differences in the Ratings of Incandescent Lamps and Arc Lamps

SINCE the introduction of nitrogen-filled tungsten lamps the conviction has become general that the only candle-power rating which has a certain distinct meaning is the mean spherical candle-power. With older types of electric incandescent lamps, which had in general similar curves of the distribution of candle-power in space around the lamp, the ratio of the mean horizontal candle-power to the mean spherical candle-power was approximately fixed so that when the mean horizontal candle-power was given the mean spherical candle-power could be easily determined. With the new

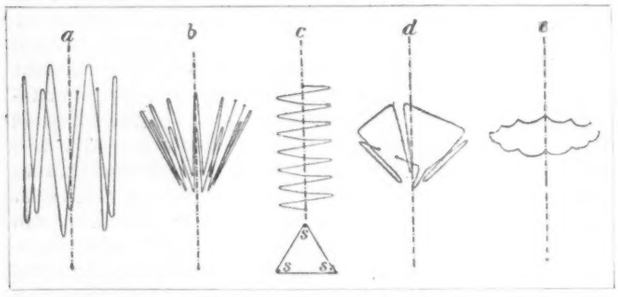


FIG. 1—ARRANGEMENT OF FILAMENT IN VARIOUS NITROGEN-FILLED TUNGSTEN LAMPS

nitrogen-filled tungsten lamps, in which the filament is arranged in many different ways, this is no longer the case, because the distribution curves of the candle-power around the lamp are so very different in different types. Nevertheless, there are some points in which these different points coincide, and on the recognition of this fact a simple method of photometric measurement may be based.

This matter has lately been investigated by Prof. K. Zickler of Brünn, Austria, and the results are given in an interesting paper published in the *Elektrotechnik und Maschinenbau* (Vienna) of Sept. 26 and Oct. 3, 1915. The arrangement of the filaments in the different lamps where were investigated is given in Fig. 1. The author determined the distribution curve of the candle-power for all these lamps in detail and found that the curves cut each other approximately at points at an angle of 54 deg. against the vertical for the lower hemisphere and at an angle of 126 deg. against the vertical for the upper hemisphere, as shown in Fig. 2. The curves *I, II, III, IV* and *V* in Fig. 2 correspond to the filament arrangements *a, b, c, d, e* in Fig. 1 respectively. From this fact the author deduces the result that it is sufficient to measure the mean candle-power or the rotating lamp only in the two directions of 54 deg. and 126 deg. against the vertical. If these two values of candle-power are called $I_{54\ deg.}$ and $I_{126\ deg.}$ respectively, the mean spherical candle-power is with sufficient practical accuracy equal to 0.478 times the sum of $I_{54\ deg.}$ and $I_{126\ deg.}$ The exact figures for the five types of lamps of Fig. 1 are as follows:

	I 54 Deg.	I 126 Deg.	I Sph. Calc.	I Sph. Meas.	Difference, Per Cent
I.....	21.8	20.5	20.2	20.1	+0.5
II.....	26.9	23.9	24.26	23.7	+2.4
III....	21.2	20.6	20.0	19.9	+0.5
IV....	29.7	25.6	26.4	26.9	−1.8
V.....	24.6	21.5	22.0	22.0	0

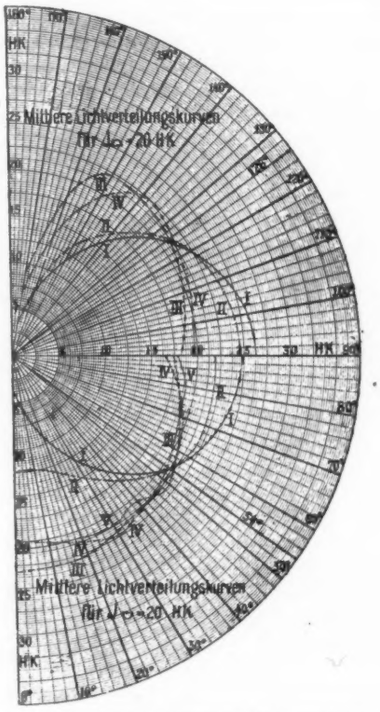


FIG. 2—CANDLE-POWER-DISTRIBUTION CURVES FOR THE VARIOUS LAMPS

In this table the values for the mean spherical candle-power calculated by this formula are given under "*I* sph. calc.," while the next column, marked "*I* sph. meas.," gives the values found by measuring the candle-power in all directions and determining from the total diagram the mean spherical candle-power. The last column gives the differences between calculated and measured value in per cent. Further comparisons between calculation and measurement for other types of lamps show that the differences always remain below ± 3 per cent. These experimental investigations are supplemented by the author by theoretical considerations, and, finally, some notes are added on the present discussion in Germany and Austria concerning the rating and marking of electric lamps. An agreement has been reached that incandescent lamps should be universally rated by the mean spherical candle-power, but it has been recommended that on the lamp globes the candle-power should not be marked at all but that only the volts and watts

consumed should be given. Professor Zickler thinks that this last recommendation goes too far. He wants the volts and the watts consumed to be stated on the lamp globes, but he thinks that the consumer has also a right to know something concerning the light he may expect from the lamp. He recommends that besides the volts and watts the specific light output in mean spherical candles per watt should also be stated.

In the *Elektrotechnische Zeitschrift* of Nov. 25, 1915, Heyck discusses the rating of incandescent lamps by mean spherical candle-power—which he approves—and the further recommendation that this method of rating should also be extended to arc lamps—which he absolutely disapproves. He argues that from the illuminating engineering standpoint a distinction should be made between a "lighting element" (a bare source of light) and a finished lamp which is ready for use for room or space illumination and which includes fittings, reflectors, extra globes, etc. A lighting element should be rated according to the mean spherical candle-power, while for a finished lamp both the lower hemispherical candle-power and the upper hemispherical candle-power should be given. If this were not done and lamps should be generally rated according to mean spherical candle-power, an arc lamp for direct lighting and an arc lamp of the same mean spherical candle-power for indirect lighting would be rated as equivalent, which would be evidently wrong from the illuminating engineering standpoint. Incandescent lamps are simply lighting elements, according to the above definition, and should be rated according to their mean spherical candle-power. Arc lamps are finished lamps and should be rated by both their upper and lower hemispherical candle-powers. The author also recommends that the same distinction and method of rating be extended to gas lighting.

Generators, Motors and Transformers

Three-Phase Motors.—KARL METZLER.—A mathematical article on the design of three-phase induction motors. The author discusses how to determine the dimensions in order to get as small a stray flux coefficient as possible. He applies his equation to a small 5-hp. motor and a larger, slow-running 750-hp. motor.—*Elek. u. Masch.* (Vienna), Aug. 29 and Sept. 5, 1915.

"Additional Losses" in Transformer Copper.—M. VIDMAR.—A mathematical article on a new kind of "additional losses" in transformer copper due to temperature differences in the copper. The same phenomenon is strongly manifest with aluminum coils. The losses are calculated, and some hints are given how this kind of loss may be reduced by proper design.—*Elek. u. Masch.* (Vienna), Sept. 19, 1915.

Lamps and Lighting

Electric Lighting in Small Houses.—J. CLEARY.—The author describes in detail the methods adopted at Brighton, England, for dealing with the problem of wiring artisans' dwellings on a remunerative basis. In dealing with any class of property the most satisfactory course is to wire houses during construction. The Brighton houses were in existence and had to be wired afterward. In some schemes the service cable has been run along the front of a block of houses, but at Brighton the special construction of the houses did not allow this simple course to be followed. In this case lead-covered cable has been adopted, and the houses are looped together, the work being carried out inside the houses. Similarly, twin lead-covered wire is used in the internal wiring, and thus the cost per point comes out at the low price of about $2.62, including first-quality switches, holders, ceiling rosettes and drop cords. The results are satisfactory in different ways. It has provided the tenants with a good light in each room and proved to be more economical than gas; it has saved the cost of redecorating for the health committee (which was always necessary with gas) and also improved the health conditions, and it has proved beyond doubt that this class of work, given favorable conditions, can be made remunerative, thereby opening up a vast field for future operations. It is found that drawn-wire tungsten lamps have an average life of 1000 hours' use. The price per kilowatt-hour is 12 cents, which includes free lamps, free slot meter and "free installation." The average receipts per week are about 12 cents per house, and the result is found to be financially satisfactory. Lights are fixed in every room and in the hall, there being six points in the flats and seven points in the houses.—London *Electrician*, Dec. 3, 1915.

Traction

Electrolysis of Underground Structures.—BURTON MCCOLLUM AND K. H. LOGAN.—An account of an investigation which shows that the resistivity of the soil in which metallic structures are buried is of much importance with respect to electrolysis of these structures. Three methods of measuring the specific resistance of the soil, two of which do not require the removal of the soil from its original position, are described. The results of a large number of measurements of resistivity of soil samples from widely separated points in the United States are tabulated. These data show great variations in soil resistivity and indicate the desirability of a study of local soil conditions in connection with any complete electrolysis survey. The majority of soils tested have resistivities of between 1000 ohms and 5000 ohms per centimeter cube. A number of factors influence the resistivity of the soil. Increasing the pressure on a sample of soil under test tends to increase the conductance of the sample slightly, especially if the original pressure is low. Increase in moisture increases the conductance of the soil if it is not saturated with water. The amount and kind of soluble material in the soil affects its resistivity. The resistivity of soil increases as its temperature falls, especially when the freezing point of water is reached. The flow of current through the soil produces an apparent temporary increase in soil resistivity in the neighborhood of the electrodes. The relation of soil resistivity to electrolysis is considered from the standpoint of leakage from street-railway lines using the track as a return circuit. The importance of good rail bonding and of well-drained roadbed is pointed out. The relation of the various factors affecting leakage resistance—namely, character of the soil, pressure, moisture, freezing and polarization—and surface films to the electrolysis problem is described, and it is shown that a knowledge of the resistivity of the soil is of importance in estimating the danger indicated by potential difference and potential gradient measurements. It is also shown that the moisture and temperature of the soil materially affect the amount of current escaping from a grounded track used as a return circuit, and that these factors must receive due consideration in the interpretation of data obtained during an electrolysis survey.—*Technologic Paper, Bureau of Standards*, No. 26, Dec. 20, 1915.

Installations, Systems and Appliances

Electric Accidents.—The first part of the annual report of the (British) electrical inspector of factories, G. Scott Ram, on electrical accidents in power stations and factories. To prevent careless installation work, he recommends that consulting engineers and owners specify that the installation shall comply with the (British) Home Office regulations, and if it does not, that the contractor shall be compelled to put it right. The

mechanical accidents in electrical generating stations and substations are fewer by eighty-five than in the previous year, a reduction of 13 per cent. The number of electrical accidents is slightly larger—ninety-nine as against ninety-four in the previous year, with four fatalities as against three. One-half of the total accidents in electrical stations occurred to men when working on live conductors—mostly on switchboards. Eight occurred on extra-high-tension systems and three on high-tension systems. Two cases were fatal. One of these occurred in a consumer's substation to a man dusting a switch (5000 volts) in a compartment with a door normally kept locked but which he had himself opened. He was probably under the impression that the switch was dead, but the controlling switch in another compartment had been left "on." The other case was to a man working in an underground substation making contact with an inadequately protected temporary cable (2400 volts). In most of the high-tension accidents the injured persons were doing work which was unauthorized and were themselves to blame. In one case an engineer tried to do some work in a switch compartment (10,000 volts). The switch was not in use, although live on one side, and it could have been made dead by means of the isolating switches provided for the purpose. This, however, involved the taking down of a heavy iron screen, and rather than take the trouble to do this he took the risk. This accident emphasizes the desirability that such doors should be hinged or made to slide on runners so that they may be readily opened. One accident was caused through a short-circuit to the framework of the switchboard by the metal end of the insulating pole provided for operating the isolating switches. Another accident was due to the misunderstanding of a telephone message. Of the accidents on medium-pressure and low-pressure systems, sixteen were caused by making short-circuits with ordinary spanners, screwdrivers or pliers. One accident was due to a short-circuit in attempting to remove the tank on a live oil switch. Under the miscellaneous accidents, the fatal case occurred to a man who touched with his head a neutral conductor of a high-tension alternator. Several alternators were running in parallel, the neutral point of one being definitely connected to earth. It had previously been assumed that the neutral points of the other machines would be very nearly at earth potential. In this case it proved that there was 500 volts pressure to earth. The machines were of different types, and the one in question was of lower voltage than the others and connected through a step-up auto-transformer. The electrical accidents in factories are fewer by sixty-eight, or 16 per cent, than in the previous year, the number of fatalities, sixteen, being one less.—London *Elec. Eng'ing*, Dec. 2, 1915.

Electrophysics and Magnetism

Radium.—B. B. Boltwood.—An article giving a summary of the different determinations of the "life of radium," defined as the period in which half of the radium is formed into other substances. An account is given of former estimates as well as a recent independent determination by Ellen Gleditsch. The different methods which have been used for estimating the life of radium give results which are in excellent agreement with one another. This agreement increases the assurance with which the estimated values of certain important physical constants involved in the calculation can be accepted as approximating closely to the true values. The principal data are as follows: Number of alpha particles emitted per second by 1 gram of radium (element) $= 3.57 \times 10^{-10}$. The charge carried by a hydrogen ion in electrolysis $= 4.65 \times 10^{-10}$ E. S. units. The number of atoms in 1 gram of hydrogen $= 6.2 \times 10^{23}$. The mass of the hydrogen atom $= 1.61 \times 10^{-24}$ gram. The number of molecules in 1 cu. cm. of any gas at standard pressure and temperature $= 2.72 \times 10^{19}$. The volume of the radium emanation in equilibrium with 1 gram of radium = 0.62 cu. mm. calculated = 0.63 cu. mm. found. The rate of production of helium per year per gram of radium = 163 cu. mm. calculated = 164 cu. mm. found.—*Science*, Dec. 17, 1915.

Units, Measurements and Instruments

Oscillating Systems.—A. Blondel and F. Carbenay.—It is generally admitted that the damping of recording instruments is practically proportional to the speed, and in the same way the oscillation of a large number of mechanical or electrical systems is usually dealt with. As a matter of fact, there are many cases in which this simple assumption is incorrect on account of the presence of a discontinuance force which is opposed to the effect producing the oscillation. This is, for instance, the case with pivot friction in recorders. The authors analyze in this serial the part played by this supplementary friction, and more generally the rôle of a term of discontinuance damping in all free or forced oscillating phenomena in which inertia, elasticity and the ordinary damping effect are concerned. They also show how it is possible to measure the characteristic constants of the "complex damping" effect and to utilize the resonance phenomenon. Finally they indicate how by analogy one may derive the same results for electric oscillation phenomena. Experimental confirmations are given for a particular interesting case in which the very important influence of hysteresis as a cause of damping in the oscillation of a bar of soft iron is manifest.—*La Lumière Elec.*, Nov. 27 and Dec. 4, 1915.

Wave-Shape in Testing—Gustav Benischke.—An illustrated English translation in abstract of his recent German paper on variations in the wave-shape in high-tension testing installations.—London *Electrician*, Dec. 17, 1915.

Telegraphy, Telephony and Signals

Wireless-Telegraph Receiving Station.—J. Bethenod.—A mathematical article on a wireless-telegraph receiving station operated by continuous waves produced by high-frequency machines. The author determines mathematically the conditions of maximum efficiency.—*La Lumière Elec.*, Oct. 2, 1915.

Wireless-Telegraph Receiving Station.—H. de Bellescize.—The author first discusses mathematically the different energy transformations in a wireless-telegraph receiving station and determines the efficiencies of the different transformations and the total efficiency. He then discusses the operation of a receiving station with reference to damping, tuning and coupling.—*La Lumière Elec.*, Oct. 16, 1916.

Miscellaneous

Exposition in Berne.—F. Niethammer.—An illustrated article describing the various exhibits of Brown, Boveri & Company at the National Exposition in Berne, Switzerland.—*Elek. u. Masch.* (Vienna), July 25 and Aug. 2, 1915.

Hartmann.—A sketch from the pen of J. Epstein of the life and work of the late Eugen Hartmann of Hartmann & Brown, physical and electrical instrument makers in Frankfort. He was one of the founders of the German Association of Electrical Engineers.—*Elek. Zeit.*, Nov. 18, 1915.

Sauer.—A biographical sketch with portrait of the late Hubert Sauer, director of the Vienna Municipal Electricity Works.—*Elek. u. Masch.* (Vienna), July 25, 1915.

T. D. YENSEN

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Trygve D. Yensen, whose production of vacuum-fused iron having a permeability four or five times that of the best magnetic iron or iron-alloy heretofore produced, has attracted wide attention in the scientific and industrial fields, has, in recognition of this work, just been appointed research assistant professor of electrical engineering at the University of Illinois, Urbana. Mr. Yensen was born in Christiania, Norway, in 1884, and was graduated from the University of Illinois in 1907, taking an M.S. degree in 1912 and an E.E. degree in 1913. In 1907 his thesis for his B.S. degree won him the Edison Medal of the A. I. E. E. Following graduation he served for a time in the testing department of the General Electric Company and later became assistant engineer of the Shawinigan Water & Power Company of Montreal, Canada. Iron of extreme chemical purity and remarkable magnetic properties has been produced by Mr. Yensen by melting electrolytically refined iron in an electric furnace in a vacuum, thus preventing contamination by surrounding gases during the melting process. The maximum of magnetic permeability of this iron was found to be about 20,000, which is two or three times as high as that for the best magnetic iron or alloy. Later, by alloying the vacuum-fused iron with silicon, the maximum permeability was raised to above 50,000. Meanwhile the hysteresis losses of the silicon-iron alloys have been found to be from one-fifth to one-twentieth of the corresponding losses for ordinary grades of iron.

E. C. Ryder, who has been general counsel of the Bangor (Me.) Railway & Electric Company, has been elected president of the company, succeeding the late John R. Graham.

Alva Apple of Fortville, Ind., has been appointed superintendent of the municipal electric-light plant at Pendleton, Ind., succeeding Frank Rector. Mr. Rector has moved to Muncie, Ind., where he will enter business.

H. K. Lugger, formerly local manager of the North Coast Power Company, Vancouver, Wash., successor to the Washington-Oregon Corporation, has been appointed master of maintenance for the North Coast Power Company.

Clarence W. Marsh has announced the opening of an office at 201 Devonshire Street, Boston, Mass., as consulting and chemical engineer. For twelve years Mr. Marsh was chief engineer and director of the Hooker Electrochemical Company of New York City, and he has devoted particular attention to the manufacture of electrolytic caustic soda, bleach and chlorine products.

H. E. Cleland, formerly advertising manager and manager of the copy-service department of the Hill Publishing Company, New York City, has joined the organization of the McGraw Publishing Company, Inc., and, effective Jan. 10, was appointed business manager of the ELECTRICAL WORLD. Mr. Cleland has had an exceptionally broad experience in publicity and modern sales methods employed in the distribution of engineering products.

H. L. MONTGOMERY

H. L. Montgomery, who has been appointed general manager of the Atlantic City (N. J.) Electric Company, succeeding Frank H. Golding, was formerly general manager of the Ohio Light & Power Company, Newark, Ohio. The Atlantic City company, like the Newark company, is one of the properties of the American Gas & Electric Company.

Frank M. Tait, president of the Dayton (Ohio) Power & Light Company and past-president of the National Electric Light Association, was the guest of honor at a dinner tendered by the board of directors of the Dayton Company in connection with its recent annual meeting, and as a token of regard was presented with a handsome large bronze clock. On the dial, in place of the usual numerals, there were etched the portraits of the twelve directors, and in the center of the group appeared the portrait of Mr. Tait.

C. H. HODSKINSON

Charles H. Hodskinson has been appointed head of the bureau of statistics of the Edison Electric Illuminating Company of Boston, Mass., the bureau having been formally established on Jan. 4 with headquarters at 70 State Street, Boston. Mr. Hodskinson, who through his work with the national associations is one of the most widely known men in the central-station field, is a native of Salem, Mass., and was educated in the local schools and at the Salem Business College. Entering the service of the Boston Edison company twenty-three years ago as an office boy, he later had nine years of varied experience in the accounting, supply and distribution departments, during which time he held the chief clerkship in each. Fourteen years ago Mr. Hodskinson became identified with the executive offices of the company and has since been the chief assistant of President C. L. Edgar with reference to statistical work, including the preparation of commission data, analyses for the board of directors, and many other financial and operating investigations. Mr. Hodskinson was a prime mover in the organization of the New England Section of the National Electric Light Association, under the direction of Mr. Edgar, and was the first secretary and treasurer of the section. From 1910 to 1912 inclusive he served the N. E. L. A. with conspicuous ability as master of transportation. He was recently elected treasurer of the Massachusetts Electric and Gas Association, the membership of which now represents over 90 per cent of the lighting utility interests of the State. Under his new title with the Boston Edison Company Mr. Hodskinson will have executive charge of all the statistical work of the company.

Obituary

George A. Redmond, one of the organizers of the Rochester (N. Y.) Electric Light Company, and later superintendent of the old Brush Electric Light Company of that city, is dead at Rochester, at the age of sixty-eight years. Mr. Redmond was a member of the A. I. E. E. and served for several years as a member of the executive committee of the National Electric Light Association.

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Modern Projector Equipment Designed for Flood-Lighting

By L. C. Porter

The principle of flood-lighting has recently been applied to outdoor publicity in a way that has filled a long-felt want, making it now possible to illuminate from a distance a sign, the entire side of a building or any other large area, and in this way to extend the advertising effectiveness of the display, sign or building into the hours of darkness when it would otherwise be lost to sight and public attention.

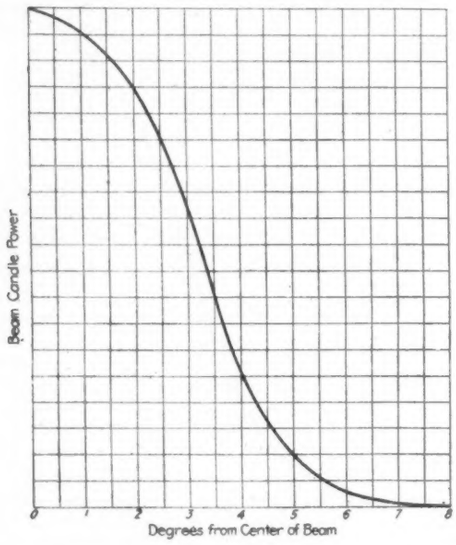


FIG. 1—DISTRIBUTION CURVE FOR BEAM FROM 500-WATT LAMP IN PROJECTOR

Publicity by flood-lighting does not conflict with the ordinary electric sign, but rather supplements it. Electric signs are generally installed on brightly lighted thoroughfares or surrounded by bright backgrounds and require, therefore, high intrinsic intensities. Flood-lighting, of course, does not show up to good advantage under such conditions. On the other hand, such advertising matter as signs painted on water tanks, tall chimneys and other more or less inaccessible places can be economically and well illuminated by flood-lighting, thus continuing the advertising value of the signs after dark.

For illuminating such displays it is simply necessary to install a flood-lighting projector at any convenient spot within 100 ft. to 500 ft. of the sign and train the beam of light onto the area to be lighted.

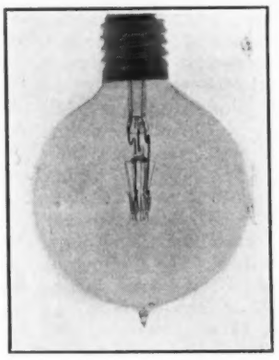


FIG. 3—500-WATT EDISON MAZDA FLOOD-LIGHTING LAMP

The flooding of the entire outside surface of a building, statue, fountain or other object with light is most effective, particularly where the subject illuminated is white or light in color. There are many beautiful pieces of architecture which, so lighted, will continue to be admired after dark and thus become dignified advertisements for the owner and the illuminating company. In fact, buildings so lighted are frequently more conspicuous after dark than during the day, on account of contrast with their surroundings.

FIG. 2—MERCHANT'S WALL SIGN AND A FACTORY WATER TANK, EACH LIGHTED BY A SINGLE PROJECTOR UNIT

FIG. 4—FLOOD-LIGHTING WITH NITROGEN-FILLED PROJECTOR LAMPS USED TO EXPEDITE CONSTRUCTION WORK

THE PROJECTOR EQUIPMENT

The General Electric flood-lighting projector used in a number of these installations and illustrated herewith consists of a highly polished aluminum reflector, a heat-resisting cover glass, and a simple focusing device, by means of which the beam may be varied from a 5-deg. to 15-deg. spread. The entire unit is well ventilated but weatherproof. It can be screwed or bolted onto any convenient place, such as a roof, a side wall or a pole. The complete unit measures 16 in. in diameter and weighs about 30 lb. The cover glass is hinged to facilitate lamp renewals.

These projectors have been particularly designed for use with 500-watt G-40 bulb "Mogul"-base Mazda C flood-lighting lamps. However, 100-watt and 250-watt focus-type filament lamps can also be used if desired. There is available a simple adapter from medium to "Mogul" base for these lamps. The accompanying curve shows the distribution of this projector equipped with a 500-watt flood-lighting lamp and focused for maximum concentration of the beam.

LAYOUT OF INSTALLATION—SURFACE INTENSITIES

When installing flood-lighting units to illuminate the face of a building, it is good practice to choose two locations for the projectors, each at least 100 ft. away and diagonally from the corners of the structure to be lighted. By having the illumination come at two different angles in this way, deep shadows from projections on the building will be minimized and a more even distribution obtained. The sketch shows such a lighting scheme and indicates the method of distributing the various beams of light.

The question of the intensity and wattage necessary is one which depends largely upon local conditions. If the object to be lighted is of light color and is seen against a dark background, probably 0.25 watt per square foot of area lighted is ample. If, however, the object is dark in color or surrounded by objects which are also illuminated, it may be necessary to use 0.5 watt or even 1 watt per square foot.

Flood-lighting has also been applied with advantage to the illumination of outdoor theatricals, pageants and athletic grounds. This method of lighting has, of course, the great advantage of ease of installation for temporary work. The projectors can be so located that the light sources are not visible to the audience. Color screens can be used and the beams easily varied from narrow spot-light effects to broad fan-shaped beams to cover large areas.

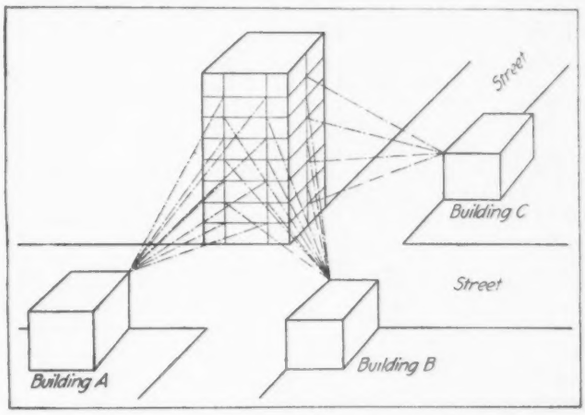


FIG. 5—LOCATION OF PROJECTOR LAMPS ON ADJACENT STRUCTURES TO ILLUMINATE CORNER BUILDING

There are innumerable other uses to which flood-lighting projectors can be put, such as lighting winter sports, construction jobs, manufacturing plants, prison walls, freight wharves, clock towers, advertising banners, confetti bombs in place of fireworks, rifle ranges, etc.

Motor-Driven Ironers

The ironing machines shown herewith are operated by small motors, and the ironing rollers, which are provided with polished-iron surfaces, may be heated either by electricity or gas. The material to be ironed is held in place by padded rollers. The axles of the padded rollers fit in bearings held in place by springs and adjustable hand-screws so that perfect contact, it is asserted, can be maintained between the padded rollers and the ironing roller.

The class A machine, as it is called, is equipped with three compression rollers, which are heavily padded with felt and muslin and arranged around the heated ironing cylinder in such a way as to give an ironing surface 90 in. wide by 8.5 in. long. The locking and unlocking of the padded rollers can be effected easily and quickly by means of a bar running the full length of the machine. Pulling the bar toward the operator raises the padded rollers from the heated cylinder and pushing it from the operator lowers the rollers, locking them securely into place. An additional roller is provided on the feed table to aid the operator in feeding the material to the

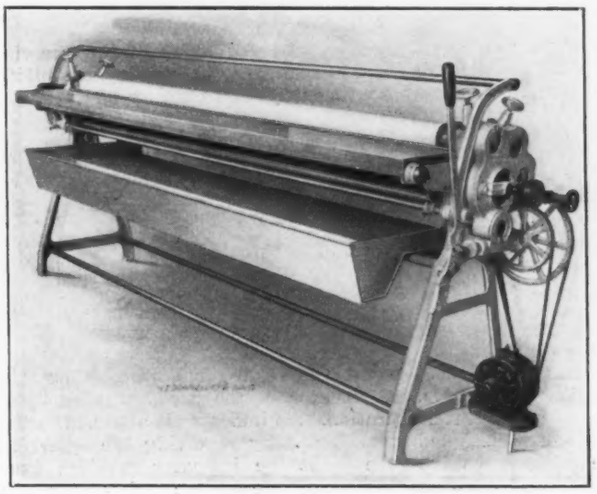


FIG. 1—LARGE-SIZED TWO-SPEED THREE-ROLL IRONING MACHINE

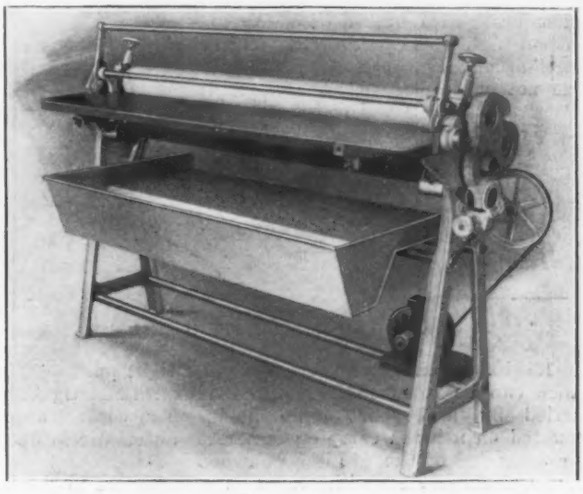


FIG. 2—TWO-ROLL MOTOR-DRIVEN IRONING MACHINE

machine. The material on coming out of the machine drops on to the lower table and may be removed either from the front or rear of the machine. The machine is operated by a 0.25-hp. motor and is designed especially for use in laundries, large hotels, clubs, hospitals and other institutions where great quantities of work are to be done.

What is called the class B machine, designed for use in private homes, laundries, hotels, clubs, etc., is shown in Fig. 2. It is provided with a 42-in. ironing surface. Use is made of a convex ironing shoe which works the material on the outside between the padded rollers and the heated ironing surface, thus allowing the steam to escape. The machine is equipped with two padded rollers and the material is thus given two ironings while going through the machine but once. The heated convex shoe is built into the machine in such a manner as to permit a partly revolving movement. This feature is advantageous, the manufacturer points out, when ironing articles having uneven surfaces, as it will not tear the fabric but roll over it. All kinds of flat work can be ironed on this machine, such as napkins, tablecloths, sheets, pillow slips, curtains, lace and all kinds of embroidery, etc. The two rollers are of steel, heavily padded with felt and muslin, to give them a spring-like action when rolling over the cloth.

Munitions Inspection Lamps

Not the least remarkable feature of modern shell construction is the minute care with which every part is inspected at each stage of its construction. One of the most important and at the same time one of the most awkward of the inspection operations is that of examining carefully the interior of the shells. To facilitate this operation the two lamps shown herewith have been developed by English manufacturers.

The British Thomson-Houston Company, Ltd., of Mazda House, 77 Upper Thames Street, London, E. C., England, has brought out the hand-lamp illustrated in Fig. 1. It is equipped with a stout brass-wire guard with top and bottom plates, which forms a "squirrel cage" accommodating a tubular lamp of size not exceeding 4.875 in. in length by 1.5 in. in diameter. This guard, which can be removed if required, is carried by a bayonet lamp holder mounted on a brass carrying rod. At the outer end of the rod is a boxwood handle, incorporated with which is a sturdily constructed push-bar switch. The lamp is supplied as illustrated, ready wired with 12 ft. of "35/40 workshop flex," which is fastened to a "cocus adapter" for connecting to existing lighting circuits. In every respect, the maker asserts, this useful accessory is built to withstand hard service, and it can be supplied in any length desired.

Another type of shell-inspection lamp illustrated in Fig. 2 has been developed by Simplex Conduits, Ltd., of Garrison Lane, Birmingham, England, for illuminating the interior surface of shells and other munitions. The lamp is designed for rough factory use, and is equipped with a robust push switch in the handle and a strong guard for the lamp. Small tubular lamps are employed. To avoid the risk of shock to the operator the lamp-holder is insulated from the body of the apparatus and the metal portion is grounded by using a three-pin plug and socket.

Electrically Operated Pump

Several interesting types of pumps adapted for motor drive have recently been placed on the market by the Deming Company, Salem, Ohio. Among these are the "Atlas" double-acting power pump for wells and cisterns 25 ft. deep or less and the "Atlas Junior" self-contained outfit consisting of a 180-gal. pump, 53-gal. tank and 1/6-hp. motor. The "Atlas" pump adapted for type CI drive, as it is called, is shown in Fig. 1. The outfit includes a tight pulley, 20 in. in diameter or less, with belt tightener of the gravity type. The control apparatus of the outfit is automatic in operation and is designed to start and stop the pump when the pressure in the tank employed with the system rises or falls below a predetermined maximum or minimum point. The pump is also adapted for what is called the type B drive, consisting of intermediate gear and rawhide pinion for connecting to the motor mounted on iron sub-base, and the type C drive, which is the same as the type CI drive except that a cast-iron sub-base is provided. The "Atlas" pump is equipped with a brass-lined cylinder which is cast in one piece with the base. The gearing is machine-cut and fully guarded, the ratio being five to one.

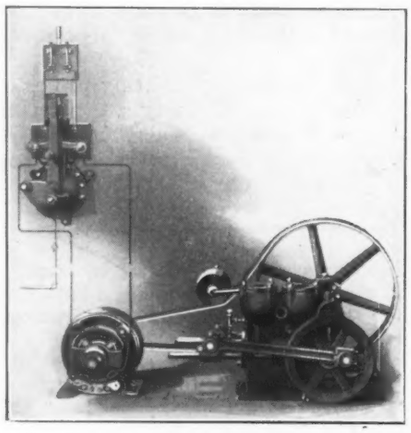


FIG. 1—MOTOR-DRIVEN DOUBLE-ACTING PUMP

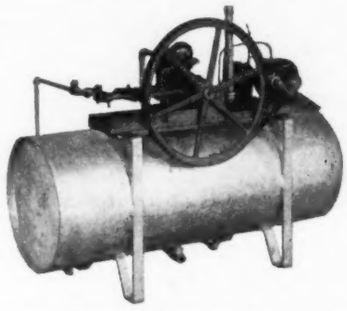
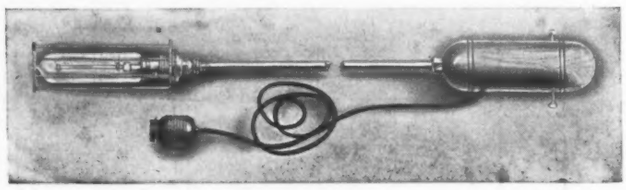


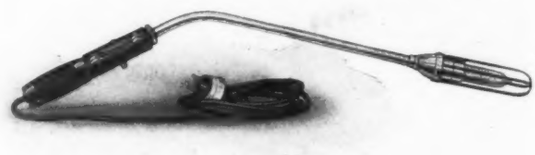
FIG. 2—SELF-CONTAINED ELECTRIC PUMPING OUTFIT

The self-contained outfit shown in Fig 2 consists of a pump, a motor and electrical appliances which are mounted on an 18-in. by 48-in. horizontal tank. Economy of space and freedom from contact with damp floors and walls of cellars are advantages claimed for this outfit. If lack of floor space will not permit the use of a horizontal tank, a vertical tank of any desired capacity can be substituted. An adjustable spring-belt tightener is employed to take up the slack in the belt and prevent slippage. The usual maximum and minimum pressures maintained are 40 lb. per square inch and 20 lb. per square inch respectively. The complete outfit is 54 in. long, 18 in. wide and 38 in. high.

Electric Hot-Water Urn

The "lighthouse" urn shown herewith, which has recently been brought out, is another electrically operated device of attractive appearance which is certain to add to the enticements of soda-fountain concoctions. The device is designed for quick-heating service and has no easily breakable parts. Both heating units and the flow of water are controlled by the handwheel shown in the center in the accompanying illustration. An indicator is attached to the wheel, and by revolving the wheel to the right the indicator revolves over the nameplate on the face of the urn and gives the operator all the necessary





FIGS. 1 AND 2—GUARDED TUBULAR LAMPS DESIGNED FOR USE IN INSPECTING THE INTERIOR OF SHELLS

information. Use is made of two heating units for providing low heat and high heat. With the reservoir filled with water at ordinary temperatures, 6 oz. of water can be brought to a temperature of 135 deg. Fahr. in ninety seconds on high heat. The urn is designed to operate on circuits of from 100 volts to 125 volts, either alternating current or direct current. The heating element is constructed of material which will not deteriorate at a temperature below that giving a dull red heat.

ELECTRICALLY HEATED WATER URN

The coils are of substantial non-corroding resistance wire, and therefore, it is claimed, can be left on the circuit for an indefinite time without damage, provided that the heating well and the bottom of the urn are filled with water. Use is made of a reservoir entirely of metal, which is provided with a low, deep well that can be easily emptied and cleaned thoroughly. The height of the water is indicated on the protected glass water gage at the right, and a small red pilot lamp at the base of the urn shows whether or not the circuit is closed. The urn is 18 in. high, is mounted on a 10-in. base, and has a capacity of 1.5 gal. It is being placed on the market by the Liquid Carbonic Company, Thirty-first Street and Kedzie Avenue, Chicago, Ill.

Sealable Fuse Plugs

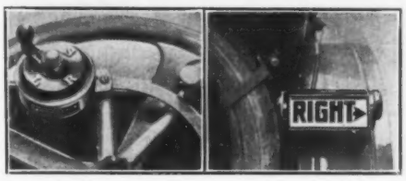
The Metropolitan Engineering Company, 30 East Forty-second Street, New

FIGS. 1 AND 2—SINGLE SEALABLE FUSE PLUGS AND PLUGS INSTALLED IN CUT-OUT

York, has recently brought out the sealable fuse plugs shown herewith for use by central stations to prevent interference or tampering with circuits. The plugs are of porcelain, the heads being slotted to permit of passing a sealing wire through their bodies so that two or more fuses may be sealed in position in a cut-out. The ordinary meter seal may be used for this purpose. Dummy plugs, as well as those equipped with fuse elements, are being made. Among the uses to which these fuses can be put are the following: (1) For "cut-off" customers, or those disconnected for non-payment, dummy fuses are placed in the cut-out and sealed in position to prevent unauthorized reconnection; (2) for "flat-rate" circuits any size of plug fuse can be sealed in the cut-out to limit the load on the circuit, and (3) for the control of any circuit where it is desired to limit the amount of current the fuses of any desired size are installed and sealed in position.

Electric Rear-Car Signal Device

An electrically operated automobile signaling device which can be included in the category of "safety-first" appliances is the "Nokolyd" rear signal shown herewith. The device is designed to indicate whether the car on which it is mounted is to be stopped or to be turned to the right or the left, and may be operated by the automobile storage battery or by ordinary dry cells. As soon as any signal is set the current is automatically cut off; hence the actual energy consumption is quite low. The controlling mechanism shown in Fig. 1 is fastened to the steering wheel. Within the case is an automatic-stop device which operates in the same way as a telegraph call box. At the rear of the car is a dust-proof box inside of which

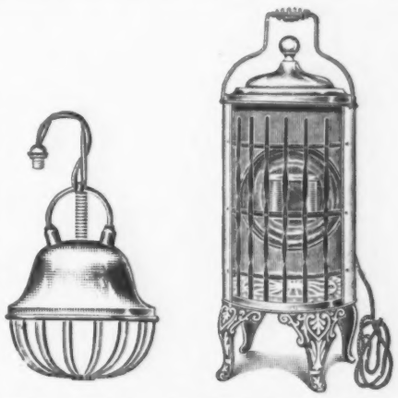


FIGS. 1 AND 2—CONTROLLING MECHANISM AND SIGNALING DEVICE AT REAR OF CAR

is a square member with four faces, three of which are marked "Stop," "Right" and "Left" respectively, while the fourth space is plain white and indicates when the controller is in the neutral position. The controlling lever may be turned to four positions, indicated by the letters S, R, L and O respectively, the square member in the rear being turned by an electric magnetic device so that "Stop," "Right," "Left" or the blank space will be shown, corresponding to the letters marked on the controller. When the controller is turned one complete revolution without stopping at intermediate points, the square member at the rear of the car will also turn one complete revolution. The "stop" signal shows white letters on a red background, the "right" signal black letters on an orange background, and the "left" signal white letters on a green background. Both the "right" and the "left" signals are supplemented by arrows, showing the direction which the car will take. By day the signal is plainly visible, it is claimed, for a considerable distance, and at night it is illuminated. A small bell rings when the signal is given, informing the operator that the instrument has registered correctly. The device is being manufactured by the Nokolyd Signal Company, 40 West Thirteenth Street, New York.

Electric Air Heaters

Several types of electrically operated heaters the units of which are designed to attain a temperature of 2000 deg. Fahr. have been developed by the Majestic Electric Development Company,



FIGS. 1 AND 2—AIR HEATERS OF SUSPENSION AND PORTABLE TYPES

428 O'Farrell Street, San Francisco, Cal. In Fig. 1 is shown one of the heaters for extension from ceiling or bracket. It is especially adapted for heating small rooms, nurseries, bathrooms, offices, etc. A special reflector is provided for reflecting the heat downward. The device is rated at 480 watts and is convenient for travelers to take in their bags or trunks for use in hotels or temporary lodging. A portable heater of the stove type equipped with a guard in the front and a handle for carrying purposes is illustrated in Fig. 2. The cold air is drawn up through two heating elements. It is provided with nickel-plated trimming and dome and reflector and white-enameled or black-enameled back and guard. The heater is 27 in. high and weighs 14 lb. It is rated at 960 watts.

Fiber-Covered Flashlamp

The advantages of a non-short-circuiting flashlamp to automobilists, engineers, mechanics and everyone else whose work brings the lamp into con-

TUBULAR FIBER-COVERED FLASHLAMP

tact with metal objects are quite apparent. The fiber-covered flashlamp illustrated cannot, according to the manufacturer, the Interstate Electric Novelty

Company, 29 Park Place, New York, be short-circuited under any conditions. Flashlamps of the type shown herewith are being made by the above-named manufacturer in eight different sizes, ranging from the "baby" tubular lamp shown in the illustration, which can easily be slipped into the pocket, up to large powerful miners' lamps, which are designed for rough usage.

Light-Weight Dental Engine

An ingenious little motor, said to be the smallest commercial machine on the market, weighing only 4 ounces and designed for operating dentists' drills and other types of dental instruments, has been developed by Dr. H. A. Whiteside, a practicing dentist of 24 East Forty-eighth Street, New York. Dr. Whiteside first conceived the idea of such a machine in 1894 while in charge of a clinic in the Ohio College of Dental Surgery, University of Cincinnati. At that time he had in mind a small motor-driven hand-piece which could be placed in a dental student's instrument case and be employed as a convenient substitute for the ordinary foot-operated engine. Dr. Whiteside's first successful machine weighed 14 ounces and was tried out for the first time in 1908.

The 4-ounce dental engine, as it is called, is being made for Dr. Whiteside by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and is only 1.25 in. in diameter. It is designed to operate on either alternating current or direct current at from 6 volts to 250 volts. No gearing-down device is employed, the drive being direct, insuring a minimum amount of noise and vibration, it is asserted, and no gyroscopic effect. Variations in speed are accomplished by means of a foot controller, giving four speeds forward and reverse, ranging from 600 r.p.m. to 2800 r.p.m. The motor is powerful enough to drive a 0.5-in. grindstone on first speed and stones of larger diameters on the three highest speeds. Speed regulation can also be obtained with a portable-type controller which is employed by dentists when visiting their patients. The motor takes 40 watts.

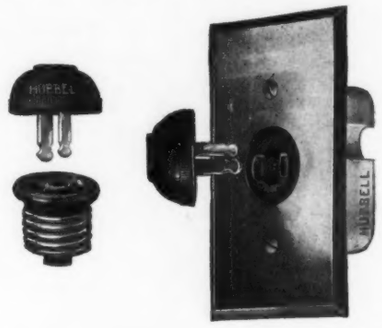
The armature shaft and its bearings are of hardened tool steel, and they are so constructed that they can be oiled from the outside. Enamel is utilized as an insulating material. No silk-insulated or cotton-insulated wire is employed. The motor and hand-piece are insulated from each other so that there is no danger of shock either to the operator or patient. The temperature rise is very low, and the machine can be given the hardest kind of grinding usage that a patient would tolerate, it is claimed, without becoming too warm.

The floor controller is operated in the usual manner and is generally placed at the rear or at the side of the patient's chair. A protected cable leads from the floor controller to a metal connecting wall-block which is fastened to the wall or woodwork. Seven feet of cord is attached to the engine with a four-point connecting plug which telescopes into the four-point receptacle on the front of the wall box, thus enabling the operator to connect or disconnect the engine in a moment. The light portable controller is equipped with a four-point receptacle of similar design, which also takes the four-point connecting plug on the end of the engine cord.

The advantages of a small dental engine of the type described above are many. The fact that it is free from the vibration of cables, duplex springs, joints, pulleys, wheels and belts makes it a simple device and proves its superiority to both patients and operators. It can be placed on a table or cabinet alongside of the other instruments and does not have an alarming appearance. At the close of the day's work the engine can be disconnected and locked in a drawer of the dentist's cabinet, desk or safe, thus preventing injury by employees during closing hours. The machine is especially convenient for use by dentists who call at patients' homes or visit them in hospitals. For the purpose a leather carrying case is provided with compartments so arranged as to carry all the necessary instruments, medicines, filling materials and engine, with the portable-type controller, cord and attachment plug to connect to a lamp socket in the patient's home or hospital. This carrying case is 11 in. by 8 in. by 4.5 in.

Polarized Attachment Plug and Receptacles

A new line of polarized attachment plugs and wall and flush receptacles has been brought out by Harvey Hubbell, Inc., Bridgeport, Conn. In Fig. 1 is shown a small separable polarized attachment plug and in Fig. 2 a polarized flush receptacle which are characteristic of the line. The polarized feature has been accomplished by making one knife-blade contact smaller than the other in both length and width and also reducing the size of the slot in the base proportionately. The larger blade is of standard size and cannot, therefore, be inserted in the small slot; hence it is impossible to insert the cap in the base in any way but the right way.



FIGS. 1 AND 2—PLUG AND RECEPTACLES WITH KNIFE-BLADE CONTACTS OF UNEQUAL SIZES

The variation in the length of the knife blade is also of assistance, the manufacturer points out, in making rapid connections, since by rotating the cap the longer blade is led into the proper slot by the bevel and at the same time the opposite blade is automatically engaged. The cap can be interchanged not only with the complete line of polarized receptacles but also with the entire line of T-slot wall and flush receptacles made by the above-mentioned manufacturer. The concealed-contact feature which distinguishes various types of Hubbell plugs is retained in this line, commending itself to those who desire the greatest possible degree of electrical safety.

FIGS. 1 AND 2—DENTAL ENGINE IN HAND OF OPERATOR, AND COMPLETE OFFICE OUTFIT, INCLUDING ENGINE, FLOOR CONTROLLER, WALL BOX AND FOUR-POINT CONNECTING PLUG

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Two New Plants to Deliver 25,000 Kw. for San Francisco Territory

Pacific Gas & Electric Company Is Building Extensions of the Drum Project, Including 79-Mile Transmission Line to San Francisco

Two new power houses known as No. 4 and No. 5 in the Drum project are being constructed by the Pacific Gas & Electric Company for supplying additional load in the San Francisco Bay region. This company develops most of its power north of Sacramento, delivering it to the San Francisco territory via the Cordelia substation. In providing the additional transmission-line capacity to convey energy from the new stations a north and south line will be constructed which will tie into the Electra line just east of Stockton, from which point the existing lines would be used in connection with a short cut across the lower end of the bay at the Dumbarton bridge.

The additional 25,000 kw. which the new plant will deliver will be absorbed partly in San Francisco and partly in outlying cities. The energy which is now generated by steam in Sacramento and also in Oakland substations will be replaced by energy from the new plants when these are in service. Thus the two new plants will take the load of the auxiliary steam stations, will increase the reserve supply of the system, and will materially increase its flexibility and dependability by virtue of the new route to San Francisco as well as its connection via the Drum line with the main transmission arteries.

The two plants will both be supplied with water from the 22-mile canal which was built two years ago to convey water from Bear River to the irrigation districts near Auburn which this company supplies. The canal terminates near Plant No. 4, a few miles above Auburn, and water is conveyed from the canal to the plant through a riveted steel pipe, varying from 8 ft. to 6 ft. in diameter, which delivers the water under a head of 342 ft. From the tailrace of Plant No. 4 the water enters a 5½-mile canal leading to the forebay of Plant No. 5, whence a steel pipe line 6000 ft. long conveys it to the power house, delivery being made under a head of 520 ft.

From the tailrace of Plant No. 5 the water is delivered into the irrigation system which the company maintains. There is a possibility of this water being still further used in a plant lower down which would be known as No. 6, provided that the irrigation requirements in later years warrant such development.

The steel work for the power house at Plant No. 4 was erected and the crews were ready to begin pouring concrete on Jan. 1. This plant will be equipped with two 9000-hp. Allis-Chalmers turbines, which will drive a single 12,500-kw., 6600-volt Westinghouse generator. Plant No. 5 will be equipped with the 20,000-hp. Pelton-Doble waterwheel of the Francis type that was on exhibition in Machinery Palace at the Panama-Pacific International Exposition. Plant No. 5 will have the same type of generating unit as No. 4.

The entire electrical installation at both plants will be practically the same. A single bank of transformers will be used with H-6 General Electric switches from which the lines will run direct to the transformers. The only difference in the transformer connections will be that at Plant No. 4 the current will be taken off at 110,000 volts, requiring what is really a three-winding transformer, while at Plant No. 5 the connections are for 60,000 volts only.

The reason for this difference in voltage is that from Plant No. 4 a 110,000-volt tower line will run north to connect with the transmission line from Drum power house, while from Plant No. 5 a 60,000-volt transmission line will run south for a distance of about 63 miles and connect with the 60,000-volt line from Electra just east of Stockton. The tower line south of Plant No. 5 will eventually be used under a tension of 110,000 volts, so that tower construction and insulators are according to specifications for the higher voltage. At present a single circuit will be installed, and this will later be made a double circuit. The line construction will be practically the same as on the line from the Drum power house, having 70-ft. towers spaced 800 ft. apart.

At the present time the route of the transmission line from Plant No. 4 north is being brushed out and the tower footings will probably be placed in the early spring. The towers for the entire length of the transmission line will have concrete footings. Most of the property rights on the line from Plant No. 5 south have been acquired, but active construction on this section of the work will not be started until summer time. It is estimated that the two plants will be put in service about November, 1916.

Attack on Muscle Shoals Development

Representative Frear of Wisconsin delivered an attack on the general rivers and harbors bill Monday in the House of Representatives, in advance of the introduction of the bill, in which he declared that the project to harness Great Falls at Washington, D. C., so as to provide cheaper light, power and heat, as well as an increased water supply, for Washington is being held up uselessly. He criticised the engineer department of the United States Army, declaring that the Great Falls project is being held up while at the same time the engineers are urging the government to spend millions of dollars "in the far-off backwoods of northern Alabama." He had reference to the Muscle Shoals improvement project in that State, which has been the cause of many hard fights in Congress. He characterized the Great Falls project as one of the most worthy before Congress and said that the Muscle Shoals project had no merit at all. Concerning this later development Mr. Frear said:

"Although Washington's water supply is an imperative question, General Kingman refuses to recommend the submission of an estimate. General Kingman recommends immediate advancement of $18,700,000, nevertheless, for the Alabama Power Company, although the hearings show that no present demand exists for power. Heretofore it was demonstrated that the Alabama improvement may cause an eventual loss to the government of $50,000,000 to aid a private power company."

Activities of Associated Manufacturers of Electrical Supplies

During the month of December marked progress was made in the formation of sections of the Associated Manufacturers of Electrical Supplies and in the work of sections already formed. As already noted in these columns, on Dec. 14 there was a meeting of the manufacturers of panelboards and switchboards, at which time a section covering that branch of the industry was formed.

Last Wednesday afternoon there was a meeting of the molded or formed insulations section held at the Hotel Biltmore, New York, to consider the formation of a separate section for vulcanized fiber, and for the appointment of standing committees. Earlier in the day the manufacturers of outlet boxes, conduit boxes, covers and accessories met and formed a new section. The manufacturers of porcelain products also held a meeting at the Hotel Biltmore and formed a porcelain products section.

The officers and standing committees of the sections recently formed are as follows:

Snap-Switch Section.—Shiras Morris, Hart & Hegeman Manufacturing Company, Hartford, Conn., chairman; Frank E. Watts, Hart Manufacturing Company, New York, secretary; J. C. Dallam, General Electric Company, Schenectady, N. Y., treasurer. Standing committees—flush switches, five members; surface switches, three members; pendent and miscellaneous switches, three members.

Knife-Switch Section.—J. H. Trumbull, Trumbull Electric Manufacturing Company, Plainville, Conn., chairman; T. A. McDowell, Westinghouse Electric & Manufacturing Company, Pittsburgh, secretary; P. J. Shelly, Metropolitan Electric Manufacturing Company, Long Island City, N. Y., treasurer. Standing committees—knife switches, mounted and unmounted, five members; knife switches mounted on porcelain, five members; knife switches, disconnected and miscellaneous, five members.

Fuse Section.—H. R. Sargent, General Electric Company, Schenectady, N. Y., chairman; R. C. Buell, the Johns-Pratt Company, Hartford, Conn., secretary; F. V. Burton, Bryant Electric Company, Bridgeport, Conn., treasurer. Standing committees—cartridge fuses, five members; plugs and open fuses, five members; cut-outs and accessories, five members.

Molded or Formed Insulations Section.—E. B. Hatch, Johns-Pratt Company, Hartford, Conn., chairman; R. W. Seabury, Boonton Rubber Manufacturing Company, Boonton, N. J., secretary; Joseph Steinberger, General Insulate Company, Brooklyn, N. Y., treasurer. Standing committees—molded rubber insulation, fiber insulation, suspension and third-rail insulation, high-heat molded insulation, molded composition insulation, and miscellaneous insulation.

Standardization of Station Operating Costs Discussed by New York Section, A. S. M. E.

At the annual meeting of the New York Section of the American Society of Mechanical Engineers, held Jan. 11 in New York City, the program for the coming year was reviewed. The local committee plans to appoint three new sub-committees, one responsible for ways to make those attending meetings acquainted with each other, another responsible for planning and conducting excursions to points of engineering interest in the city, and a third in charge of entertainment features. Members of these committees are to be selected from names submitted by members. It is the aim of the local section to make its meetings during 1916 attractive as well as profitable.

In the paper presented at this meeting on "Standardization of Power-Plant Operating Costs" the author, Walter N. Polakov, outlined a suggestion which he proposed as a method by which the owner of a power plant may judge how close actual performance is to the possible minimum cost at any time. He advocated a classification of expenses into two groups, one constant for any output and one variable in some direct proportion with the output; the use of curves showing standard costs; standardization of protective charges for standby equipment, and comparisons of costs and efficiencies of different plants.

The paper was discussed by George L. Fowler, H. G. Stott, Prof. William Kent, John W. Lieb, J. C. Percy, J. A. Kinkead and Selby Haar. The discussion brought out the considerable difference of opinion on the methods and basis for standardization of costs. One speaker maintained that a segregation of costs was more important than standardization unless the latter were based upon thermodynamic efficiencies and cost of power. Another speaker referred to the necessity of considering the heating value of coal in standardization methods so as to compare boiler-room performance of different stations on the same basis. It was the opinion of a number of those taking part in the discussion that, while the aim of the author was in general good, the standardization proposed would meet with serious obstacles and be of little practical value.

House Passes Ferris Water-Power Bill

The House of Representatives has passed the Ferris water-power bill, providing for the development of water-power on public lands, and it has been referred to the Senate committee on public lands. In the House the measure had the support of Representative Mann and other leading Republicans, although it is characterized as an administration measure and is part of the administration's conservation program.

The bill was amended in a number of important particulars, one of which extended its provisions to Alaska. Another important amendment was: "That each lease under this act shall be conditioned upon the acceptance by the lessee of all the terms and conditions of this act and of conditions authorized by law and specified in the lease, which acceptance shall be expressed in the lease. Another amendment was the placing in the bill of the language: "Nothing in this act shall be construed as affecting or intended to affect, or in any way to interfere with, the laws of any State relating to the control, appropriation, use or distribution of water."

During the debate on the bill in the House, Representative Mondell of Wyoming referred to two features which he characterized as "iniquitous." One of these provided that by passing a transmission line over a State border all control over the operations of a power company and all control over its rates would cease and be transferred from the State to the Secretary of the Interior. Also, Mr. Mondell said: "Even admitting that it is right and just for the federal government to lease its land and charge rental for power development, there certainly could be no justification or defense of legislation under which a great power plant, all on private land, would, if compelled to use even a small fraction of public land of little value, be laid under a heavy federal charge having no relation to the value of the public land used, thus placing a burden which must be paid by consumers and depriving the State of a portion of its power of taxation."

The bill will soon come up in the Senate.

Public Service Commission News

Pennsylvania Commission

On complaint that the Eastern Pennsylvania Light, Heat & Power Company refused to extend its mains a distance of 350 ft. from their former terminus because the laying of the additional main would not be profitable, the Public Service Commission of Pennsylvania held that the rights, powers and privileges which are conferred upon public service companies are likewise accompanied with duties and obligations. It is a part of the contract with the commonwealth that they shall perform the service undertaken as a whole. The public service company, holding a monopoly as it does, cannot be permitted to select the most profitable parts of the service and, supplying them, treat such performance as a compliance with its duty. While that which is unreasonable will not be required, it may be stated as a general proposition that a corporation which undertakes to light a borough must be ready to furnish reasonable lighting to all parts of the borough.

New York Commissions

The annual report of the New York Public Service Commission for the First District shows that during 1915 the commission awarded contracts aggregating about $26,000,000. Almost $20,000,000 of these contracts were for subway and elevated railroad construction. The running expenses of the commission amounted to about $3,600,000 for the year, of which $3,000,000 was devoted to rapid-transit work. The commission employs about 2300 persons. There are at present under the jurisdiction of the commission more than 100 corporations in addition to some holding companies and trunk-line railroads entering the city of New York. Of these companies thirty-one are gas, electric and steam companies having a combined capitalization of $411,602,806. The commission received during the year 5732 complaints, a decrease of 704 from the year 1914. The report shows that during 1914 electric companies sold 687,582,209 kw.-hr. and received from sales $34,878,022. The gas and electric companies combined paid during the year aggregate dividends of $12,556,486 and together showed an accumulated surplus of $60,938,642. The receipts for sales of electric energy were equivalent to about $6.40 per capita. During the year the commission authorized the issuance of securities by public-service corporations to the extent of about $23,000,000. This makes a total of $635,159,477.64 authorized during the life of the commission, namely, from July 1, 1907, to Dec. 31, 1915. The total amount of all applications for such securities filed during this period was $824,160,657.48.

Governor Whitman of New York State has sent to the Senate the names of Oscar S. Straus and Henry W. Hodge as members of the Public Service Commission for the First District, the former to fill out the unexpired two-year term of Edward E. McCall, recently removed from office, and the latter to serve out the unexpired three-year term of R. C. Wood, resigned. The plans of the Governor call for Mr. Straus to resign his position on Feb. 1, when the Governor will appoint him for the full five-year term in the place of J. Sergeant Cram, whose term expires on that date. That will leave still unprovided for on Feb. 1 the commissionerships now held by Mr. Straus and by George V. S. Williams, whose resignation takes effect on that date.

California Commission

In the case for the establishment of rates to be charged by the Pacific Gas & Electric Company in San José the California Railroad Commission held that a fair allowance for overhead percentages on estimated reproduction cost of hydroelectric, steam and transmission construction is as follows: One year's construction period, 20 per cent; two years', 23.5 per cent; three years', 27 per cent. An allowance of two months' operating expenses for working capital was held to be a just and reasonable amount. As regards the apportionment of investment in individual steam plants, the commission held that, though on the face it would appear that such investment is more or less assignable to the immediate locality in which the plant is situated, it is more proper to consider such plants as feeding the system as a whole, particularly as in times of low production at the hydroelectric production centers the steam plants are called upon to develop considerable energy for consumption throughout the system as a whole.

Colorado Commission

The Colorado Power Company in serving the Primos Mining & Milling Company was granted a right-of-way for its high-tension lines across the mining company's property and permission to inspect, repair and maintain these lines, which at all times were to be under the control of the power company. In the contract for service there appeared the following clause, to which the mining company objected as unreasonable and which the two companies placed before the Public Utilities Commission of Colorado for a decision: "The user shall indemnify the [power] company from all demands and expenses for injury or damage to person or property upon or about the property of the user, except injury to the company's employees, and not caused by the act or negligence of the company." The commission held that the clause was both unreasonable and inequitable and should be stricken from the contract.

Massachusetts Commission

The Public Service Commission has issued its third annual report. The advance copy is a volume of 185 pages, and in addition to the usual statistical data of transportation, telephone and telegraph company operations for the year ended June 30, 1915, contains an exhaustive report on the rise and fall of the jitney bus and an investigation of the cost of energy in 1914 to the street railways of the State, taking the twenty-five larger companies. Fourteen of the twenty-five companies purchase energy. In its recommendations for legislation the commission asks for $25,000 to enable an investigation of telephone rates to be conducted at Boston.

Idaho Commission

The annual report of the Public Utilties Commission of the State of Idaho shows that fewer cases were filed during the year covered by the report than during the preceding year. Among the most important cases that occupied the attention of the commission were an investigation into electric light and power rates in southern Idaho, reduction of electric rates in some towns served by the Washington Water Power Company, and the issuance of rules and regulations governing pole and wire construction. The report shows the following utilities of record: One auto-stage line, six electric railroads, fifty-two electric companies, eleven express companies, four gas companies, one sleeping-car company, sixteen steam railroads, thirty-eight telephone companies, eight telegraph companies, seven vessels, twenty-six warehousemen and sixty-five water companies. This is an increase of thirty-two utilities over last year. Of this number, nine had commenced during the year—that is, two electric railroads, two electric companies, two water companies, two express companies and one auto-stage line. The other twenty-three utilities were operating but failed to report to the commission.

Revenue per Ton of Refrigerating Capacity.—It is estimated by the Philadelphia Electric Company that the average revenue per ton capacity for refrigerating plants on its lines amounts to $150.

Women Electricians for England.—The Electric Contractors' Association of Liverpool, England, has decided to train a number of women in electrical work in order to release men for military duty.

Lead Production in 1915.—The production of refined, antimonial, desilverized and soft lead from foreign and domestic ores in 1915 was approximately 585,550 short tons, as compared with 558,789 tons in 1914.

Price of Lead During 1915.—The price of lead per pound in New York rose from 3.8 cents in February, 1915, to 7.56 cents in June, and closed the year at about 5.4 cents. The average price during the year was 4.7 cents, compared with 3.9 cents in 1914 and 4.4 cents in 1913.

Radio Communication Established Between Tahiti and San Francisco.—The first wireless message from the station completed recently by the French government at Papeete, Tahiti, was received in San Francisco Jan. 5. The station is approximately 3500 miles from San Francisco.

Raise Valuation of Wisconsin Electric Utilities.—The preliminary valuation of the property of Wisconsin street-railway companies and light, heat and power companies operating in connection with them made by the State Tax Commission for 1916 is $64,973,000, an increase of $3,000,000 over 1915.

Smoke Ordinance Held Valid.—The power of cities to enact ordinances against the emission of smoke of a certain degree of density for a certain length of time was upheld Monday by the United States Supreme Court in pronouncing valid the Des Moines (Ia.) smoke ordinances attacked by a laundry in that city.

Embargo on Logwood Exports Ends.—The Governor of Jamaica has issued a notice removing the embargo on the export of logwood and logwood chips and extract to America and other countries. The embargo on logwood was becoming a serious matter with manufacturers of wire using a brown-colored protective braiding.

Wireless Amateurs Incorporated.—Articles of incorporation for the National Amateur Wireless Association were signed on Jan. 6 by Supreme Court Justice Ford of New York. The purpose of the new association is to prepare for war by forming amateur wireless telegraph and telephone operators into a military signal corps.

Ohio Cannot Collect Willis Franchise Tax from Corporations in Bankruptcy or in Hands of Receivers.—The United States Court of Appeals at Cincinnati handed down a decision on Jan. 4 confirming the decisions of the lower court that the Willis franchise tax cannot be recovered from corporations in the bankruptcy courts or receivers' hands.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Automobile Manufacturers to Exchange Patent Rights.—Announcement has been made that a cross-licensing agreement in connection with patent rights, which had been under discussion among the members of the National Automobile Chamber of Commerce, has been made effective by seventy-nine companies, which hold more than 350 verified patents.

Tearing Up Streets in Winter Forbidden.—In the future public-service companies having pipes, conduits, rails or other equipment in the streets of Providence, R. I., will be forbidden, except in case of emergency or absolute necessity, to extend or repair them, when such work would involve the tearing up of the street surface, between Dec. 1 and March 1 of each year.

Cleveland Company Presents Employees with Insurance Policies.—As a New Year's gift, the Cleveland Electric Illuminating Company gave each of its employees a thousand-dollar life-insurance policy. The company will pay the premiums. This insurance is in addition to the protection furnished through the State compensation fund, in which the Cleveland company participates.

Philadelphia's 90-ft. Poles to Be Removed.—The two 90-ft. chestnut poles erected by the Philadelphia Electric Company to clear the railroad bridge shown in the illustration will have to be removed because the bridge is to be reconstructed. The cost of these two poles, which have a diameter of 8.5 in. at the top and 3 ft. 4 in. at the ground line, was $125 apiece. The poles are set in concrete to a depth of 8 ft.

90-FT. CHESTNUT POLES, PHILADELPHIA ELECTRIC COMPANY LINES

Spain's Electrical Industries.—According to the latest statistics on the electrical industry in Spain, there are 992 plants furnishing electric lighting for public use and 978 such plants for private use; 125 electric plants supply motor service. There are six electric lamp factories, while four are devoted to making other electric supplies.

Plans Discussed Placing Regulation of All Public Utilities Under Nebraska Commission.—Officials of several Nebraska electric-light companies held a meeting the last week in December in Nebraska and discussed plans for securing passage through the next Legislature of a law placing the regulation of all public utilities under the Nebraska State Railway Commission.

Edison Illuminating Company of Detroit Pays Michigan Largest Automobile Tax.—The Secretary of the State of Michigan reports that the largest check received for automobile licenses last year from a single company came on Dec. 18 from the Edison Illuminating Company of Detroit. The check was for $1,683.39 to cover license plates for the various machines used by the company in Detroit.

Prize Winners in Washing-Machine Window Display Contest.—The prizes for the best Electrical Prosperity Week window display featuring the Thor washing machine which were offered by the Hurley Machine Company of Chicago have been awarded as follows: First prize of $100, Arkansas Valley Railway, Light & Power Company, La Junta, Col.; second prize of $75, Public Service Electric Company, Montclair, N. J., and third prize of $50, Northern Indiana Gas & Electric Company, Hammond, Ind.

Finding on Economy Refillable Fuses.—In the findings of the Bureau of Standards in regard to Economy refillable fuses, published in the ELECTRICAL WORLD of Jan. 1, the words "cartridge fuses at present listed as standard by the" were omitted from the first paragraph. The paragraph should read: "It has not been shown that the use of the fuses manufactured by the Economy Fuse & Manufacturing Company will result in greater fire or accident hazard than the use of inclosed cartridge fuses at present listed as standard by the Underwriters' Laboratories, Inc."

Los Angeles Prevented by Law from Acquiring Distributing System.—That the city of Los Angeles is prevented by insurmountable legal obstacles from acquiring the distributing system of the Los Angeles Gas & Electric Corporation, or any part of it, is the substance of a communication from R. M. Adams, secretary-treasurer of the corporation, to the chairman of the committee on extension of the Los Angeles Department of Public Service. "By the terms of trust deeds all the property of the Los Angeles Gas & Electric Corporation is conveyed in trust to trustees as security to the holders of the bonds issued by it and its predecessors," Mr. Adams stated. "These covenants are such that neither the whole nor any part of the property could be sold, even with the consent of the trustees."

Right to Operate Lines in Streets.—The right of a telephone company to operate its lines through the streets of a city is held by the Supreme Court of Iowa (154 N. W. 678) to be subject to regulation under the city's police power.

Right of City to Access to Utility's Books. — In granting an extension of franchise to the Wichita Railroad & Light Company the city of Wichita provided for annual verified statements from the company showing its earnings and expenses, for the purpose of taxation. The city now seeks by instituting a proceeding in mandamus to compel the company to permit an audit and inspection of its books in order to verify its statements. The Supreme Court of Kansas held (152 P. 768) that since the action at hand was in the nature of a bill of discovery the writ of mandamus could not be employed.

Injury to Property Caused by Erection of Flashboards.—By erecting flashboards at its dam the Pennsylvania Water & Power Company caused the flooding of certain lands, and a bill was filed to enjoin the company from so increasing the height of its dam. It was argued by the company that the injunction should not be granted since the remedy would result in greater injury to the defendant company than that which had been caused to the plaintiff, and, moreover, that the injury is not irreparable. The Supreme Court of Pennsylvania (95 A. 717), however, upheld the injunction, holding that there was no doubt as to the right of the plaintiff to the protection of a court of equity.

Validity of Regulation of Hours for Firemen.—The "stationary-fireman" act of Louisiana provides that a full day's work shall be eight hours and no more and makes it a misdemeanor to compel a stationary fireman to work longer than eight consecutive hours in one day in a city having a population of 50,000 or more. The Supreme Court of Louisiana has handed down the opinion (70 S. 70) that the act is an arbitrary and unreasonable discrimination against the employers and employees embraced within its provisions, that it invades the fundamental right of freedom of contract, and finally that it has no real or reasonable relation to public health, public morals or public safety and is beyond the police power of the State.

Oral Contracts.—The city of Brownsville, Tex., contracted orally through the city superintendent to furnish energy to a motion-picture theater and later, because of an indebtedness made prior to the contract, the city cut off the theater's supply, whereupon suit was brought against the city for damages. Among other things the city contended that it could not be bound since the contract was oral. However, the court of Civil Appeals of Texas held (179 S. W. 107) that, since the statutes authorizing cities to construct light plants and water-works are silent as to how contracts shall be made with their customers, and since the superintendent who made the contract had express authority to make oral or written contracts, the city's contention was without merit.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public-utility companies.

Defective Handling of Lines.—It was held by the Court of Appeals of Kentucky (179 S.W. 251) that a limitation made by the owner of the land on the method of fastening wires does not excuse companies for injury caused by defective fastening of wires.

Assurance of Safety in Ditch Digging. — It was held by the Supreme Court of Tennessee (179 S. W. 808) that a foreman in charge of digging a ditch had a right to make in good faith assurances of the safety of the ditch in order to keep the men at work, and that such assurances would be binding on the part of the employer.

Provision of Safe Working Place.—A wireman's helper brought suit against the Southern California Edison Company for injuries received from falling against some live wires because the wireman under whom he was working suddenly jerked a bit out of a hole thereby causing the helper to fall against the wires. The District Court of Appeals in the Second District of California held (151 P. 757) that nonsuit was properly granted upon a count based upon the claim that the place where the helper was to work was not reasonably safe, inasmuch as he was an experienced electrician and aware of all dangers of the place where he was employed at the time of the accident.

Rehearing Before a Commission.—A hearing on an application for a rehearing at a time and place fixed by the California Railroad Commission, when the matter was submitted for final decision on the merits of the controversy, is sufficient to warrant the commission to dismiss the complaint and to vacate its former order restraining an individual from constructing a hydroelectric system to compete with the complaining company, according to the California Supreme Court in the case of the Mount Konocti Light & Power Company vs. Max Thelen et al. (P. U. R. 1915, E. 291), although the commission has no authority to change or vacate a former order without giving the adverse party an opportunity to be heard. The provision of a statute "that if a public utility, in constructing or extending its line, plant or system, shall interfere or be about to interfere with the operation of the line, plant or system" of an established public utility, the commission on complaint may make such order for the location of the systems affected as may be just refers solely to an interference with the physical operation of the system of the public utility already constructed, and cannot be invoked by one utility to prevent another from extending its lines to be able to compete with it.

Assumption of Risk.—The Court of Appeals of Kentucky held in the case of White versus Louisville Gas & Electric Company (179 S. W. 418) that a laborer directed by his foreman to remove a wooden horse from its position across a freshly cut ditch assumed the obvious risk of the ditch caving in from his placing his weight too close to the edge.

Safety Belt an Appliance. — A telephone lineman injured by falling from a pole when the snap on his safety belt became unfastened brought suit for damages, claiming that the telephone company was negligent in furnishing an unsafe appliance. The safety belt was held by the Supreme Court of Iowa (154 N. W. 591) to be an appliance, and action for injuries resulting from its use must be judged under the law providing for safe appliances for use by employees.

Reasonable Time for Replacing Defective Parts. — Fairbanks, Morse & Company sold the Twin City Supply Company an oil engine, guaranteeing good material and construction and free replacement of parts that might prove defective within a year, without assuming liability for any damages caused by such defect. Provision was made for the reservation of title as security for purchase-money notes and that acceptance of the engine, when delivered, should cause all claims for damages by reason of any delay to be waived. It was not contemplated, however, the Supreme Court of North Carolina decided (86 S. E. 1051), that the seller should be allowed an unreasonable or indefinite time to make good any defect in the engine, but only a reasonable time to do so.

Injury to Lineman Caused by Falling of Decayed Pole.—A lineman in the employ of the Bell Telephone Company of Pennsylvania who was injured by the falling of a pole on which he was working and which was shown to be decayed at the base sued the company for damages for personal injuries. The Supreme Court of Pennsylvania (95 A. 579) held that while it is true that an employee is deemed to assume such risks as are ordinarily and reasonably connected with his employment, and while he is presumed to have notice of those dangers which are obvious, it is equally true that the employer is charged with the duty of maintaining and keeping in reasonably safe repair instrumentalities and appliances used in the operation of the business so as not to expose the employee to dangers not ordinarily or reasonably incident to the employment. While it was contended that the pole in question belonged to a lighting company and had been used jointly by the two companies for years, the burden of proof of ownership was on the telephone company, and the lineman had the right to assume the safeness of the pole in question. The court would not agree that the breaking of the pole was due to the negligence of a fellow workman who cut the wires. The proximate cause of the injury was the breaking of the pole, which resulted from its decayed condition, a fact which, it was held, was easily discoverable by proper inspection.

Philadelphia Jovian League.—A business meeting of the Jovian League of Philadelphia was held at the Hotel Adelphia on Jan. 6.

Association of Iron and Steel Electrical Engineers. — The next monthly meeting will be held at the Seventh Avenue Hotel, Pittsburgh, Pa., on Jan. 15.

Wisconsin Electrical Contractors' Association.—The annual meeting of this association will be held on Jan. 17, 18 and 19 at the Hotel Wisconsin, Milwaukee.

Philadelphia Section, I. E. S.—W. D'A. Ryan will speak at the Jan. 21 meeting of the Philadelphia Section of the Illuminating Engineering Society on "Illumination Problems at the Panama-Pacific Exposition."

Pittsfield Section, A. I. E. E.—Prof. W. I. Slichter of Columbia University spoke before the Pittsfield Section of the American Institute of Electrical Engineers on Dec. 30 on "Education for a Career in Electrical Engineering."

Michigan Engineering Society.—The thirty-seventh annual convention of the Michigan Engineering Society will be held at Grand Rapids, Mich., on Jan. 18, 19 and 20. Papers will be presented of special value and interest to those engaged in state, county and city work.

Pittsburgh Section, I. E. S.—The regular monthly meeting of the Pittsburgh Section of the Illuminating Engineering Society will be held on Jan. 21 at the rooms of the Engineers' Society of Western Pennsylvania. T. W. Rolph of Cleveland will present a paper on "The Laws of Reflection and Transmission of Light."

Annual Convention of New Mexico Electrical Association. — The annual convention of the New Mexico Electrical Association will be held in Albuquerque Feb. 14, 15 and 16. The headquarters will be at the Alvarado Hotel. E. A. Phiele, 112 West Third Street, Roswell, N. M., is secretary-treasurer of the association.

St. Paul Society of Electrical Contractors.—The newly organized Society of Electrical Contractors of St. Paul, Minn., held its first business session at the North Central Commercial Club rooms on Dec. 22 with a discussion of trade matters. Officers of the society are: E. S. Drake, president; Thomas Daly, vice-president, and R. H. Eddy, secretary and treasurer.

Utah Society of Engineers.—E. C. La Rue, United States drainage engineer, delivered a lecture before the Utah Society of Engineers on Dec. 17 in Salt Lake City on the Colorado River Basin. F. M. Thebo, superintendent of the Oneida plant of the Utah Power & Light Company, gave an address on the "Engineering Feats of the Big Creek Hydroelectric Plant."

Los Angeles Jovian League.—Ernest Ingold, vice-president of the Jenner-Ingold Company, whose business is advertising and selling, spoke at the Dec. 8 meeting of the Los Angeles Jovian Electric League on "After-Effects." Benjamin F. Pearson, general superintendent of the Southern California Edison Company, spoke at the Dec. 29 meeting on "The Snowflake in Industry."

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

New England Section, N. E. L. A., Holds Boston Luncheon.—One hundred and seventy-five members and friends of the New England Section of the N. E. L. A. attended a luncheon at the American House, Boston, Mass., Jan. 6, to organize monthly meetings at which informal question-box discussions of electrical topics will be featured. The meetings will be held on the first Thursday after the first Monday until summer.

Brooklyn Company Section, N. E. L. A.—At the next meeting of the Brooklyn Company Section of the National Electric Light Association, to be held Jan. 18, the annual review of the progress made by the company during the previous year will be outlined in an illustrated talk by T. I. Jones, general sales agent of the Edison Electric Illuminating Company of Brooklyn. W. F. Wells, vice-president and general manager, will also be among the speakers.

Electrical Contractors' Association of Missouri.—The semi-annual meeting of the Electrical Contractors' Association of Missouri will be held at Kansas City on Jan. 15, when the date of the annual meeting will be changed from midsummer to January and the election of officers will be held. The semi-annual meeting of July will hereafter be held either at St. Louis or Kansas City, in accordance with the location of the national convention, for the convenience of Missouri members. The Kansas association will meet informally with the Missourians at the session next week.

Roof Raising Marks Passing of Old-Time Electric Building.—Members of the Commonwealth Edison Company section of the N. E. L. A. and other employees of the company on Dec. 29 conducted a "roof raising at old 120 West Adams Street," the building which had for so many years been the central-station headquarters in Chicago. With the coming of 1916 the old building has ceased to be used for electrical purposes, and the fête was arranged to celebrate its abandonment and the complete occupation of the company's new home in the Edison Building.

Lecture on Storage Batteries at Franklin Union, Boston.—John W. Cooke, engineer for the Electric Storage Battery Company, gave an illustrated lecture on storage batteries before the classes in telephony and industrial electricity at the Franklin Union Dec. 15. A miniature storage cell capable of being placed in a lantern was projected on the screen, in order to illustrate the effects of too rapid charging and discharging. By means of lantern slides Mr. Cooke also showed the various methods of installing batteries, as well as their wide industrial application.

Inventors' League Elects Officers.—At the annual meeting of the Inventors' League of the United States, held in New York, Dec. 27, the election of officers for 1916 resulted as follows: President, George Whigelt; first vice-president, Thomas R. Beggs; second vice-president, F. K. Maximilian; treasurer, E. A. Munns; corresponding secretary, R. J. Lackner; financial secretary, H. D. Haggerty; custodian, M. Shampanier.

New England Section, I. E. S.—At the first 1916 meeting of the New England Section of the Illuminating Engineering Society, which was held at the Engineers' Club, Boston, Mass., on Jan. 13, Dr. Louis Bell led the discussion on the general topic for the evening—"Flood-Lighting." Two meetings of the section will be held on Feb. 16. At the afternoon session, to be held at the General Electric Company's building in West Lynn, Mass., the topic will be "Street-Lighting Problems as Solved by Miniature Streets," and the evening session, to be held at Lynn, will be addressed by W. D'A. Ryan on "Illumination at the Exposition." At this session the section will meet jointly with the Lynn Section of the American Institute of Electrical Engineers. A gas meeting will be held at the Engineers' Club, Boston, on March 16, and on April 13 Dr. C. P. Steinmetz, president of the society, will address the section in Boston.

Ohio Electric Light Association Committee Meetings. — As announced in these columns on Dec. 25, the standing committees of the Ohio Electric Light Association will hold meetings at Akron in January on succeeding days as follows: Transmission and distribution committee, Jan. 18; new-business co-operations committee, Jan. 19, and meter committee, Jan. 20. The program for the new-business co-operations committee was announced in the ELECTRICAL WORLD of Jan. 8. The program of the transmission and distribution committee has been arranged as follows: Address of welcome by H. B. Bixler, superintendent lighting division of the Northern Ohio Traction & Light Company, Akron, Ohio; "Erection of Transmission Lines," by Mr. Howard, Wheeling (W. Va.) Electric Company; "The Porcelain Industry," by M. A. O. Austin, chief engineer Ohio Insulator Company, Barberton, Ohio. In the afternoon the members will make an inspection trip through the Ohio Insulator Works, and the evening will be given over to a talk and demonstration of resuscitation by E. S. Lyon, coroner of Summit County, Ohio. The principal subject for consideration at the meeting of the meter committee will be "Maximum-Demand Determinations and Modern Apparatus for Recording the Same." Representatives of prominent manufacturers of these apparatus will be on hand to give demonstrations.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturing and Industrial

Steam-Boiler Business Booming

Beginning with the fall months, the demand for steam boilers began to break all former records. Throughout the first half of 1914 industrial conditions were slack and the boiler trade was correspondingly depressed, while in the last half of 1914 the bottom dropped out of the market. Early in 1915, however, the volume of orders began slowly to increase, only to fall off again during the summer months. With the easy money market, the return of better business conditions and the threatening aspect of the raw material market in the fall, orders for boilers began to pour in until at the present time manufacturers find themselves booked far ahead of their normal capacity. Almost all the orders are for boilers in electric power plants.

The reasons for this large influx of orders are evident. For almost two years construction work was at a standstill. During this time there was, of course, little or no industrial growth that would demand additional boiler equipment, but there was a growth in the central stations' output which cut down to a large extent their reserve boiler capacity. With the return of industrial prosperity there was an immediate demand from the industrial plants, because of increased output, for increased motive power. This same condition was felt by the central stations. More steam generating equipment became immediately necessary. Another reason is to be found in the fact that a number of plants, both industrial and utility, that had expected to make additions necessitating boilers found it economically unsafe to do so until the money market should return to a safer plane. This meant that a number of orders that would have been placed earlier were held back until the fall. Moreover, it was generally known that owing to the advancing prices of raw materials a corresponding advance would take place in boilers, so that many plants that were expecting to purchase boilers later began to place orders earlier. Also some orders are coming in from central stations in anticipation of a new load already contracted for.

Deliveries are far behind what they would be under normal conditions. There are four reasons for this—first, the congestion of the factories owing to the enormous volume of buying; second, the difficulty in getting tubing and castings, or iron and steel of any description, in anything like a reasonable amount of time; third, the scarcity of skilled labor, and, fourth, the difficulty in obtaining adequate freight service. While some manufacturers had both the foresight and the capital to stock up in raw materials when prices were low, others had not, and the latter are finding it especially difficult to supply their customers even on greatly delayed deliveries.

Second-hand dealers are also receiving many orders. With them, however, the conditions are somewhat different. Their orders are coming almost entirely from industrial plants which because of a suddenly increased output need further equipment and need it immediately. For that reason they are willing to take what they can get, provided that they can have immediate delivery. Cost is no consideration. Delivery is everything. Nothing holds up the second-hand dealers' deliveries but freight congestion, and they therefore can make deliveries just as soon as the railroad can get its cars to the customer's depot.

Credits and collections have undergone a great betterment in the last few months. Customers no longer find it necessary to demand long credits, and accounts are paid much more promptly.

As has been stated, prices have made a material advance and will continue to advance with the price of raw materials.

M. Kirchberger & Company, manufacturers of lava products, have moved their office and factory to 116 East Twenty-seventh Street, New York.

Trumbull Company Increases Wages of Employees.—On Dec. 15 the Trumbull Electric Manufacturing Company, Plainville, Conn., granted to the employees of all its departments an increase in wages of 10 per cent.

F. J. Klenck, with office at 225 Sharon Building, San Francisco, Cal., is acting as manufacturers' representative, covering the entire Pacific Coast territory and calling on the manufacturers of lighting fixtures and jobbers of electrical supplies.

Electrical Specialty Company Changes Name and Location.—The O. K. Electric Company, which formerly had its quarters at 3233 West Lake Street, Chicago, Ill., has moved its factory and office to Benton Harbor, Mich., and has changed its name to the Electric Specialties Manufacturing Company. Walter W. Hoefen is president of the new concern.

Bates Expanded Steel Truss Company Sells 400 Poles.—The Wetmore Electric Company of Lowville, N. Y., has purchased 400 expanded steel poles from the Bates Expanded Steel Truss Company of Chicago. On these poles a 44,000-volt, 15-mile transmission line will be built through the Adirondack Mountains. The poles are 35 ft. in length and will be spaced on 250-ft. centers.

A. H. Keleher, who is a traveling representative of the following concerns in all the South American countries, has established headquarters at 114 Liberty Street, New York: Pass & Seymour, Inc., Solvay, N. Y.; the Benjamin Electric & Manufacturing Company, Chicago; the Hart Manufacturing Company, Hartford, Conn.; the Hotpoint Electric Heating Company, Ontario, Cal., and the Faries Manufacturing Company, Decatur, Ill.

New Manufacturers' Agency Opened in Kansas City, Mo.—A new firm, known as the O. & M. Supply Company, at Nineteenth and Campbell Streets, Kansas City, Mo., is now doing an agency business in electrical supplies, hardware and automobile specialties. L. J. Osborne and H. E. Merrithew, members of the new firm, were formerly in the sales departments of different companies in the electrical business at Kansas City and St. Louis, Mo., respectively.

The Chicago Switchboard Manufacturing Company, with factory and offices at 426 South Clinton Street, was recently organized for the purpose of manufacturing a line of power and lighting apparatus, switchboards, panelboards, steel cabinets and electrical specialties. G. N. Jennings, for seven years secretary of the Cuthpert Electric & Manufacturing Company, is president of the new company, E. L. Brenk is secretary, and George Meyer, Jr., is treasurer.

Electric-Range Manufacturer Discontinues Chicago Office.—The Globe Stove & Range Company of Kokomo, Ind., a manufacturer of electric cooking apparatus, has discontinued its Chicago office, which has been maintained at 731 Edison Building. The entire organization, comprising both the manufacturing and sales branches of the electrical department, is now united, with its headquarters at the home office in Kokomo. P. L. Miles is sales manager and J. H. Risser is manager of the central-station department.

Extension to Plant of Electro Dynamic Company.—The Electro Dynamic Company, maker of interpole motors, is to increase the size of its present plant at Bayonne, N. J., in the near future by an addition which will be approximately 100 ft. square. The contract has already been placed with the John W. Ferguson Company of New York and Paterson, N. J. The addition will consist of one high story with mezzanine galleries, and will be built on mill-construction lines with brick walls and a felt and slag roof.

Cleveland Battery & Electric Company.—This company has opened a factory at 1974 East Sixty-sixth Street, Cleveland, Ohio, where it is manufacturing dry-cell batteries under the trade name of "Hiwatt." The batteries are of the flat type, with two or more cells combined in a unit of construction with only two binding posts. They are waterproof and are said to weigh less than the usual battery. H. B. Palmer is the inventor of the battery, while R. F. Smith is the general manager and C. E. Ward sales manager.

The Richardson-Phenix Company, Milwaukee, Wis., manufacturer of lubricating apparatus, has recently opened a branch office at 141 Fulton Street, Boston, Mass., which will be in charge of C. E. Blake, who has had many years' experience with the company in the design and installation of power-plant lubricating systems. The company has also moved its New York office to 30 East Forty-second Street. E. M. May is manager of this office and J. J. May is associated with him and will have charge of the company's "No Kut" valve department.

Gibraltar Agent Seeking Connection with American Electrical Firms.—A. E. Serfaty, P. O. box 106, Gibraltar, is desirous of becoming an agent for American manufacturers of electric motors, whose products he wishes to substitute for those formerly brought from Germany. Mr. Serfaty states that single-phase, seventy-six-cycle, 110-volt alternating-current motors with slip-rings and 440-volt direct-current motors are the machines generally used in his section. He would also like to get in touch with manufacturers of Edison screw lamp-holders of the "Continental" type, with "Continental" screws, electrical appliances, novelties, etc.

Big Demand for Wire.—Discussing the wire business in this country, a well-informed Pittsburgh banker said: "There has never been a demand for American wire to equal what our manufacturers are experiencing at present. To a great extent this is due to the war, considerable wire being utilized by the belligerent nations. In addition to that, the foreign countries which formerly were competitors of ours are now out of the market, either because they are producing none at all or else because their production is curtailed. About 50 per cent of the wire made in this country to-day is sent abroad, and this percentage could be considerably increased if it were not that our manufacturers have to take care of their domestic trade."

Ships Export Apparatus by Express.—A special transformer built by the Kuhlman Electric Company of Bay City, Mich., for a firm in Chile has been shipped from the factory to New York City by express. The unit was finished and was ready for shipment so that under ordinary circumstances time would have been available to permit its rail journey by freight. The possibility of delay resulting from the freight congestion at the Atlantic seaboard influenced the transformer manufacturer not to risk freight shipment for fear of missing the steamer sailing Jan. 8. The transformer itself is unusual. It is rated at 300 kva. and will operate at a frequency of fifty cycles. Its primary winding is designed for a potential of 5000 volts, and the secondary is a special winding. The unit complete weighs 6000 lb.

1200-kw. Electric Furnace to Be Operated on Central-Station Energy.—The Eastern Pennsylvania Power Company, Dover, N. J., a W. S. Barstow & Company property, closed a contract on Dec. 31 with the International High Speed Steel Company to supply energy for a 1200-kw. Heroult electric furnace which the latter-named company is to operate at Rockaway, N. J. The furnace will have a capacity of 50 tons of steel per day from an open-hearth furnace. The steel plant is 10 miles from the power station at Boonton, N. J., from which three-phase energy is supplied at 33,000 volts. A special type of transformer will be employed to deliver the energy to the furnace. The contract is considered one of the best for central-station service made in the above-mentioned section in a long time, and it is thought that it is a forerunner of others of like size.

Condition of Iron and Steel Market Boosts Arc-Welding Machinery.—There is at present a very brisk demand for electric arc-welding machinery. While there has always been a good call for this type of apparatus, the present conditions in the iron and steel market have greatly increased the volume of building. Small castings that become broken or from which lugs have been knocked off are now being welded together with the arc. Formerly this casting would have been thrown into the scrap pile and another one ordered with the expectation of getting the new one from stock in a couple of days, but now it is a case of waiting a couple of months or more to get delivery. There are a number of similar small jobs for which, under ordinary circumstances, the arc-welding process would prove too expensive but for which, now that time of delivery outweighs the element of cost, arc-welding is found to be economically very suitable.

$3,000,000 Weekly in Orders for General Electric Company.—Orders received during the past few weeks by the General Electric Company, Schenectady, N. Y., have been averaging in value, it is reported, about $3,000,000 a week, or at the rate of over $150,000,000 a year. These figures do not embrace the company's "special export business." As already stated in the ELECTRICAL WORLD of Jan. 8, the company's business for 1915 has been reported to be close to $100,000,000, making it the third best year in the history of the company. The largest amount of business done in any year by the General Electric Company was in 1913, when the total was $111,819,142. If the orders keep up at the present rate throughout 1916, the year will easily be a record-breaking one. In recent months the company has noted a demand not only for electrical equipment for manufacturers engaged in turning out war materials and other requirements for European armies but also for public-service companies and industrial concerns generally. The turbine business is said to be especially active at the present time.

Business of $62,000,000 for Western Electric Company in 1915.—According to a statement recently made by Gerard Swope, vice-president of the Western Electric Company, 463 West Street, New York, the total business of the company for 1915 approximated $62,000,000 in amount, as compared with $66,000,000 for 1914. The following is from a recent message by Mr. Swope to the employees of the company: "The year 1915 started out under poor business conditions, this country not having then commenced to feel the impetus which came from war business. Our business activity, both in our factory and in the distribution of all our merchandise, was accordingly much curtailed. During the year, however, conditions gradually improved, owing to the larger portion of the world's requirements in foods, raw material and manufactured products which is being supplied by the United States. This could not help but have its indirect effect upon other industries, and it has so stimulated the telephone industry and business in general that during the latter part of the year the activities of our factory and our business were much increased. We will, therefore, end the year with sales larger than we had anticipated. They will approximate $62,000,000, which is still, however, less than the business we did in 1914, when we did $66,000,000. We look forward to 1916 as a year of great activity in the factory and in all the departments of the company."

NEW YORK METAL MARKET PRICES

	Jan. 4 — Selling Prices Bid	Asked	Jan. 11 — Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	87 12 6		84 15 0	
Prime Lake	23.00 to 23.50†		23.00 to 23.50†	
Electrolytic	23.00 to 23.50†		23.00 to 23.50†	
Casting	22.00 to 22.50†		22.00 to 22.50†	
Copper wire base	24.00 to 24.50†		24.75 to 25.25†	
Lead	5.75		5.85	
Nickel	45.00 to 50.00		45.00 to 50.00	
Sheet zinc, f.o.b. smelter	23.00†		23.00†	
Spelter, spot	17.30 to 17.50		..... to 17.42½	
Tin, Straits	45.00†		41.37½	
Aluminum, 98 to 99 per cent	53.00 to 55.00		53.00 to 55.00	

OLD METALS

Heavy copper and wire	17.50 to 18.00†		17.50	to 18.50†
Brass, heavy	12.00 to 12.25†		13.00	to 13.25†
Brass, light	9.50 to	9.87½†	10.50	to 11.00†
Lead, heavy	4.75 to	4.87½†	5.12½	to 5.25†
Zinc, scrap	12.50 to 13.00†		14.50	to 15.00†

COPPER EXPORTS

Total tons to Jan. 11 4884

†Nominal.

Corporate and Financial

Arkansas Valley Railway, Light & Power Company, Pueblo, Col.—A new issue of $450,000 of three-and-one-half-year 6 per cent gold notes is being offered at 98.5 and interest. The proceeds from the sale of the notes will be used for important additions to the generating equipment and for extensions of the transmission lines, including the installation of a 7500-kw. steam-turbine generating unit at the Canon City (Col.) plant. The earnings of the company for the twelve months ended Nov. 30, 1915, were as follows:

Gross earnings	$1,166,673
Expenses, maintenance and taxes	669,281
Net earnings	$497,392
Bond interest	330,878
Balance	$166,514

British Government Announces Prices It Will Pay for British-Owned American Securities.—The British government made known on Jan. 7 the first list of prices it is prepared to pay for American securities owned in Great Britain under the plan for the mobilization of American securities. The list will be corrected daily to correspond with the market and underlying conditions. The bonds purchased under this plan are paid for in London in pounds and are to be sold in the United States for dollars, which will mean a large margin of profit on the exchange transaction, since money is worth considerably more in New York than in London. While there is a large difference between the prices offered by the British government and the New York prices, it is explained by the difference in exchange.

Consumers' Power Company, Jackson, Mich.—A block of $1,000,000 of first lien and refunding 5 per cent gold bonds is being offered at 97 and interest to yield about 5.25 per cent. The earnings for the year ended Nov. 30, 1915, were as follows:

Gross earnings	$3,819,528
Operating expenses, maintenance, taxes and renewals	1,573,082
Net earnings	$2,246,446
Bond interest	841,225
Balance	$1,405,221

Fort Worth (Tex.) Power & Light Company.—A comparative statement of earnings for the twelve months ended Oct. 31, 1914 and 1915, follows:

	1915	1914
Gross earnings	$862,874	$876,696
Operating expenses and taxes	361,702	405,813
Net earnings	$501,172	$470,883
Interest charges	114,111	102,587
Net income after charges	$387,061	$368,296
Dividends on preferred stock	66,732	66,732
Balance	$320,329	$301,564

The decrease in gross earnings was due to the smaller sales of power during this period to the Texas Power & Light Company, owing to the completion by the latter company of its Waco plant. A larger decrease in expenses, however, served to increase the net earnings over the previous twelve-month period by about $30,000.

Iowa Electric Company, Cedar Rapids, Iowa.—A block of 500 shares of 7 per cent preferred stock is being offered at 97.5 and accrued dividend.

Kansas City (Mo.) Light & Power Company.—The Kansas City Electric Light Company is making plans to comply with the orders of the Public Utilities Commission, following the adoption of plans under Judge Hook's suggestions for the separation of the railway and light interests. The Kansas City Light & Power Company has been incorporated, with paid-up capital stock of $2,000. It is said that the commission will be asked to indorse the issuance of at least $5,700,000 of securities for the company, that being the valuation placed on the light and heat company properties by the commission's experts.

Merchants' Heat & Light Company, Indianapolis, Ind.—The Public Service Commission of Indiana has authorized the company to issue $70,000 of its common stock at not less than 95 and $280,000 of its bonds at not less than 89.5. The order shows that the company has expended the sum of $351,136.67 for permanent additions and improvements at its plants and on its transmission lines, and that these improvements have not been capitalized by the company. The assets of the company were shown to be $6,873,052. The outstanding capital for the year ended Nov. 30, 1915, was $5,536,000. The money expended for improvements went in part for adding to the company's equipment to handle the street-lighting contract for the city and in part for the improvement of its stations throughout the city.

Newport News & Hampton (Va.) Railway, Gas & Electric Company.—An issue of $2,000,000 of first and refunding mortgage 5 per cent gold bonds due Jan. 1, 1944, is being offered at 91 and interest to yield 5.65 per cent.

Northern New York Utilities, Inc., Watertown, N. Y.—The Public Service Commission for the Second District of New York has authorized the company to issue a total of $541,950 in securities, with which it will pay certain debts, provide for new extensions, absorb the Cape Vincent municipal plant, the Chaumont Electric Light Company and the Thousand Islands Electric Light & Power Company, and exercise eight new town franchises in Jefferson County. The proceeds will be disposed of as follows: From the proceeds of $218,000 of the company's 5 per cent fifty-year first mortgage bonds, to be sold at 87.5, and $22,700 common and $60,000 7 per cent cumulative preferred stock, both to be sold at par, there will be paid a demand note held by John B. Taylor for $267,500, and the treasury will be reimbursed for option and interest money already paid. The Taylor note was used to purchase a water-power property on the Beaver River between Effley Falls and Baird-Violet Falls for $78,500 and property on the Oswegatchie River for $18,900. From the proceeds of $92,000 of bonds at 87.5 and $23,000 common stock and $165,000 preferred at par, making a total of $268,500, the Northern New York Utilities will pay the village of Chaumont $5,500 for its electric-light plant clear of all debts, will acquire the sixty-one shares of the Chaumont Electric Light Company's stock for $6,000 and cancel them upon merger, and will pay $26,250 for the 250 shares of the Thousand Islands Electric Light & Power Company, Ltd., also canceling these shares upon merger. It will also pay $80,182 of bills and accounts payable, spend $77,603 for new construction and reimburse its treasury for fixed assets hitherto acquired by it or through its subsidiary, the Watertown Light & Power Company, to the amount of $73,077.

Pacific Gas & Electric Company, San Francisco, Cal.—The California Railroad Commission has given authority to the company to issue $2,500,000 of first preferred stock and $2,000,000 of general and refunding gold bonds. The company is also authorized to use $2,473,046.58 cash on hand from the sale of preferred stock, together with $130,-005 due on unpaid subscriptions for this stock, to reimburse its treasury for expenses from May 1, 1914, to Aug. 31, 1915. The first preferred stock must net the company $90 a share and the bonds 85 per cent of face value plus accrued interest. The funds received from the sale of the first preferred stock and the bonds will be used to reimburse the company's treasury for plant expenditure to Aug. 31, 1915, in the sum of $491,744.43 and to pay for extensions, additions and betterments amounting to $3,150,000. This amount is necessary, the company believes, owing to the development of its business and the foreseen addition of new consumers in 1916.

St. Lawrence River Power Company, Massena, N. Y.—The Public Service Commission for the Second District of New York has authorized the company to sell to the St. Lawrence Securities Company a total of $1,941,655 of securities, the proceeds of which will be used by the Securities company toward the payment of its two-million-dollar advance to the power company for construction purposes. The power company is also authorized to purchase for $10,000 in cash all of the outstanding stock at par of the St. Lawrence Transmission Company, to purchase all the outstanding shares of the Hannawa Falls Water Power Company, paying $300,000 in cash for them at par, and to purchase all the outstanding stock of the Northern Power Company, consisting of 2960 shares to be purchased for cash at par for $296,000, and 200 shares to be purchased for $18,000 in cash.

New Utility and Industrial Companies

The Adair County Light, Power & Ice Company of Kirksville, Mo., has been incorporated with a capital stock of $100,000 by Harry M. Still, John C. Mills and Charles V. Miller.

The Dresden Electric Light Company of Dresden, Ohio, has been incorporated with a capital stock of $10,000 by Maxwell Frazier, A. Frazier, William S. Lemert, C. M. Haas and W. A. Walcott.

The Pratt Electric Company of Indianapolis, Ind., has been incorporated by Henry F. Pratt, A. T. Pratt and Edward W. Hohlt. The company is capitalized at $10,000 and purposes to deal in electrical fixtures, etc.

The Corwin Telephone Manufacturing Company of Lafayette, Ind., has been incorporated with a capital stock of $100,000 to manufacture telephone and electrical devices. The incorporators are Elmer R. Corwin, Merton J. Corwin and Junior A. Gordon.

The Burdick-Stafford Electric Corporation of Lancaster, N. Y., has been incorporated with a capital stock of $10,000 by Elmer J. Stafford of Buffalo, N. Y., and George W. Burdick of Lancaster, N. Y. The company intends to do a general electrical contracting and electrical engineering business.

The Guaranteed Magneto Parts Corporation of Brooklyn, N. Y., has been incorporated with a capital stock of $25,000 to manufacture and deal in generators, lighting outfits, vehicles, etc. The incorporators are L. H. Washburn, C. H. Spolander and H. B. Tibbetts, 1822 Albemarle Road, Brooklyn, N. Y.

The Cathay Development Corporation of Portland, Me., has filed articles of incorporation under the laws of the State of Maine with a capital stock of $1,000,000 to operate electrical industrial enterprises of all kinds, general lighting, heating, power, railway, telephone and telegraph business.

The Abner Manufacturing Company of Wapakoneta, Ohio, has been incorporated by J. H. Goeke, R. B. Anderson, Charles F. Herbst, A. J. Brown and C. A. Syueve. The company is capitalized at $25,000 and purposes to manufacture and deal in gas generators, lighting fixtures and other appliances.

The Byron Electric Light & Power Company of Byron, Ill., has been incorporated with a capital stock of $10,000 to furnish electricity for lamps and motors and deal in electrical appliances. The incorporators are Thomas M. Henck, William H. Dillon, George W. Sherman, James Woodburn and others.

The Commonwealth Utilities Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $1,000,000 for the purpose of doing a general utility business. The incorporators are Herbert E. Latter, C. L. Himlinger of Wilmington, Del., and Clement M. Egner of Elkton, Md.

The United Electrical Stores, Inc., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to manufacture electrical, gas and combination fixtures. The incorporators are W. L. Stone and Norman W. Cole of Scranton, Pa., and J. W. Swail, Wilkes-Barre, Pa.

The New Jersey Power & Light Company of Jersey City, N. J., has been incorporated with a capital stock of $2,000,000 by Albert B. Cheadle, 601 West 112th Street, New York, N. Y.; Clifton N. Wilson of Ossining, N. Y., and John M. Enright (authorized agent of the company), 75 Montgomery Street, Jersey City, N. J. The company purposes to generate and distribute electricity for lamps, heaters and motors.

The Southern Michigan Light & Power Company of Hudson, Mich., has been chartered with a capital stock of $200,000 for the purpose of taking over the properties of the Hudson Electric Light Company and the Morenci & Fayette Light & Power Company and to extend the transmission lines to a number of towns in southern Michigan and northern Ohio. The officers are: George F. Avis, president; Oren Howes, vice-president; Floyd D. Avis, secretary, and C. J. Avis, treasurer.

Trade Publications

1916 Calendar.—The Holtzer-Cabot Electric Company, Boston, Mass., is sending out a 1916 calendar which contains information on its various products.

Trolley Guard.—The Ohio Brass Company, Mansfield, Ohio, is sending out an illustrated folder which contains information on its "National" trolley guard.

Cords.—"Cords and Portables, N.E. Code," is the title of publication B-3365, which has just been issued by the General Electric Company, Schenectady, N. Y.

Una-Flow Engines.—Bulletins No. 66-B and No. 67 issued by the Ames Iron Works, Oswego, N. Y., contain information on and illustrations of Stumpf "Una-flow" engines.

Electric Washers.—The Globe Manufacturing Company, Perry, Iowa, has prepared a catalog, illustrated in colors, descriptive of its electrically operated washing machines.

Electric Washer.—The Wayne Manufacturing Company, St. Louis, Mo., has issued an illustrated folder on its vacuum type No. 50 electrically operated washing machine.

Clay Products.—The Laclede-Christy Clay Products Company, Manchester and Sulphur Avenues, St. Louis, Mo., gives information on the scope of the company's service in a folder just circulated.

Electrically Operated Rotary Planing Machines.—Catalog No. 50 issued by the Newton Machine Tool Works, Philadelphia, Pa., contains information on some motor-driven rotary planing machines.

Phonograph Motor.—The Shelton Electric Company, 30 East Forty-second Street, New York, is sending out a leaflet which contains information on its small vertical-type motors for operating phonographs.

Tungsten Lamps in Photography.—Bulletin No. 26 prepared by the National Lamp Works of the General Electric Company, Cleveland, Ohio, contains a large amount of information on the uses of "Mazda" lamps in photography.

Batteries for Farm-Lighting Plants.—"Isolite" batteries in glass jars for farm-lighting plants, burglar-alarm and fire-alarm systems are the subject of Bulletin No. 15, which is being distributed by the General Lead Battery Company, Newark, N. J.

Automatic Weighing of Coal and Water.—Bulletin No. 101, entitled "Automatic Weighing of Coal and Water in Power Plants," has been issued by the Richardson Scale Company, Passaic, N. J. It is attractively illustrated and consists of sixty-three pages.

Small Portable Motor-Driven Sewing Machine.—"Harnessing Electricity to Your Needle" is the title of a folder prepared by the Willcox & Gibbs Sewing Machine Company, 658 Broadway, New York, descriptive of a small portable motor-driven sewing machine.

1916 Model Starting, Lighting and Ignition Equipment.—Circular 1532-B just issued by the automobile equipment department of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes in detail its 1916 model starting, lighting and ignition equipment.

Battery for Isolated Plants.—Hand Book FL just issued by the Electric Storage Battery Company, Philadelphia, Pa., contains information on "Hyray-Exide" batteries for isolated plants and for lighting and power. The company has also recently prepared Hand Book HX, on "Hyray-Exide" battery and switchboard units for small electric plants.

Electric Systems for Gasoline Automobiles.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued Instruction Book No. 5140-C on its automobile ignition and lighting system, Instruction Book No. 5142-B on its automobile lighting system, Instruction Book No. 5143-B on its electric starting motors with mechanical pinion shift for automobiles, Instruction Book No. 5154 on its electric motors and generators for automobiles, Instruction Book No. 5157-A on its starting, lighting and ignition system for Ford cars, Instruction Book No. 5159-A on its automobile lighting system with automatic voltage regulation, Instruction Book No. 5160-A on its vertical ignition system of the reverse-current type for automobiles, and Instruction Book No. 5161 on electric starting motors with automatic electromagnetic pinion shift for automobiles.

New England

AUGUSTA, MAINE—Negotiations have been completed for the consolidation of the Central Maine Pwr. Co., Augusta, and the Penobscot Bay El. Co., Bucksport, and the Greenville Lt. & Pwr. Co., to be operated by the Central Maine company, subject to the approval of the Public Utilities Commission.

FRANKLIN, N. H.—Arrangements are being made by the Franklin Lt. & Pwr. Co. for the installation of an additional 360-hp. generating unit at its station. The contract for the generator has been awarded to the General Electric Co., the water-wheel is being supplied by the S. Morgan Smith Co., and a Woodward governor will be used.

LUDLOW, VT.—The question of purchasing energy from the Colonial Pwr. & Lt. Co., Manchester, to operate the municipal electric system is under consideration. As yet nothing has been decided upon. In any event nothing will be done before May. T. F. Horan is chief engineer.

BROCKTON, MASS.—Plans are being prepared by the Edison El. Illg. Co. of Brockton for an addition to its power plant in East Bridgewater, to cost about $475,000. New equipment, including two 600-hp. boilers, equipped with automatic stokers, a 10,000-kw. turbo-generator set, with condensing apparatus, switchboards, etc., will be installed. The work will be done under the supervision of the Stone & Webster Engineering Corpn., Boston.

STAFFORD SPRINGS, CONN.—A company has been organized here known as the Stafford Worsted Co. for the manufacture of worsted yarns. The company is capitalized at $160,000, and proposes to erect a new mill on the Faulkner site in the spring. The building will be 200 ft. by 115 ft., two stories high, with power house and office buildings separate. Walter Scott is general manager.

Middle Atlantic

BROOKLYN, N. Y.—Plans are being prepared by Francisco & Jacobus, architects, 200 Fifth Avenue, New York, for a power house for the American Machine Foundry Co., 346 Carroll Street, Brooklyn, to be situated at Fifty-fifth Street near Second Avenue, to cost about $12,000.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, until Jan. 17 for installing electric-light equipment in the frame buildings of Erasmus Hall High School on Flatbush Avenue near Church Avenue.

DEPOSIT, N. Y.—The Deposit El. Co. is considering the question of extending its transmission lines to Cannonsville, Delaware County, in the spring. George W. Vail is superintendent.

NEWARK, N. Y.—Bids will be received by Albert W. Beaven, president of board of managers, New York State Custodial Asylum for Feeble-Minded Women, Newark, until Jan. 25 for alterations and additions to power house, construction, heating and electric work at the New York State Custodial Asylum for Feeble-Minded at Newark. Drawings and specifications may be consulted at the above asylum, at the New York office of the Department of Architecture, 1224 Woolworth Building, and at the Department of Architecture, Capitol, Albany. Copies of drawings and specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany, upon deposit of $10. Lewis F. Pilcher is State architect.

NEW YORK, N. Y.—Edward Robinson, director of the Metropolitan Museum of Art, has asked the Board of Estimate to consider an appropriation of $110,000 to construct a new electric generating plant for the museum.

NEW YORK, N. Y.—Plans for improvements and extensions for the coming year on the properties operated by the Cities Service Co., 60 Wall Street, New York, are now being made. Included in the new construction will be four steam turbo-generators at Alliance, Ohio, Athens, Ga., and Hutchinson and Salina, Kan.; twenty new motor cars for the electric railways at Durham, N. C., Sedalia, Mo., and Cumberland, Md., and improvements and extensions at St. Joseph, Mo., Elyria and Warren, Ohio, and other cities.

PERRY, N. Y.—The Perry El. Lt. Co. is erecting a 13,200-volt transmission line to Silver Springs, a distance of 6 miles, to supply electricity at wholesale to the municipality of Silver Springs. It is expected to connect the Silver Springs line with the Warsaw plant during the coming summer and to erect a central generating station, the location not yet decided upon. C. W. Torrey is treasurer and superintendent.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

POUGHKEEPSIE, N. Y.—The installation of an electric-lighting and heating plant for the Dutchess County court house is under consideration. The cost is estimated at between $10,000 and $11,000.

ROCHESTER, N. Y.—Plans are being considered by the City Council for the installation of a new street-lighting system in the Charlotte district.

SILVER SPRINGS, N. Y.—The Public Service Commission has decided that the franchise granted to John Kimmel of the Silver Creek El. Co. is valid and legal.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., Watertown, it is reported, has started work on the development of a new power project at Elmer Falls on Beaver River, where it is expected that 2000 hp. will be developed. J. B. Taylor, Watertown, is treasurer and general manager.

WATERTOWN, N. Y.—The Public Service Commission has authorized the Northern New York Utilities, Inc., Watertown, to issue $541,950 in securities, the proceeds to be used to pay certain debts, provide for new extensions, absorb the Cape Vincent municipal electric plant, the Chaumont (N. Y.) El. Lt. Co. and the Thousand Islands El. Lt. & Pwr. Co., Clayton. The commission has also approved the erection of a plant and the exercise of a franchise therefor granted to the Thousand Islands Co. by the village of Clayton, and the exercise of franchises granted to the Northern New York company by the towns of Champion, Le Roy, Clayton, Wilna, Rutland, Cape Vincent and Hounsfield, Jefferson County.

YONKERS, N. Y.—Bids will be received by Col. Franklin W. Ward, secretary State Board of Armory Commissioners, 158 State Street, Albany, until Jan. 28 for construction, heating, plumbing and drainage and electric work of armory for Company "G" Tenth Infantry, National Guard New York, Yonkers. Drawings and specifications may be consulted at the Department of Architecture, Capitol, Albany, and at the New York office of Department of Architecture, 1224 Woolworth Building. Drawings and specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is State architect.

BANGOR, PA.—The property of the Bangor & Portland Trac. Co., Bangor, has been taken over by the Northampton Trac. Co., Easton, which contemplates some changes in the power supply and lines. One or more substations, probably of the automatic type, may be erected. Plans are now being prepared by James T. Rood, consulting engineer, Easton.

BEAVER FALLS, PA.—Application has been made through Martin & Swaney of Beaver Falls for charters for the Cloverdale El. Co., to furnish electricity for lamps, heaters and motors in Big Beaver Township, and for the Little Beaver El. Co., to furnish electrical service in Little Beaver Township. The incorporators, it is understood, are interested in an electric plant at Darlington, from which it is proposed to furnish energy in the townships named. The petitioners are W. S. Craig, Dr. R. M. Patterson, J. D. Perrott, F. C. Perrott and T. M. Gilchrist, all of Beaver County.

HARRISBURG, PA.—Application will be made to the State Department by S. D. Warriner, Rollin H. Wilbur and H. F. Baker for a charter for a corporation to be known as the Ruscombmanor Township El. Co., which is to supply electricity for lamps, heaters and motors in said township. The same parties will also make application for similar privileges in Rockland, Muhlenberg and Upper Alsace Townships.

KULPMONT, PA.—The Edison El. Co., Lancaster, it is reported, is contemplating extending its system to Kulpmont in the spring.

LANCASTER, PA.—The Lancaster & York Furnace St. Ry. Co., the Lancaster & Southern Ry. Co. and the Colemanville Wtr. & Pwr. Co., all with headquarters in Lancaster, have suspended operations for an indefinite period, owing, it is said, to financial troubles. The Coleman Wtr. & Pwr. Co. supplies electricity in Marticville, Conestoga, Centre, Pequea, Colemanville, Rawlinsville and Mount Nebo.

PHILADELPHIA, PA.—Bids will soon be asked, it is understood, for construction of power house at the Philadelphia Institution for the Feeble-Minded at Byeberry. Dr. Krusen is city director of health and charities.

PHILADELPHIA, PA.—The contract for the electrical equipment for the office building at Sixteenth and Walnut Streets has been awarded to the United El. Construction Co., Philadelphia, at $10,000. The company has also secured the contract for electrical equipment of the St. Charles Hotel at Atlantic City, N. J., for $5,000.

PITTSBURGH, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 17 for installing two cast-iron socket fixtures and two cast-iron lamp stands in the United States experimental station, Bureau of Mines, Pittsburgh, Pa.

SPRING CITY, PA.—The contract for electrical work in the new building to be erected at the Pennsylvania Institution for the Feeble-Minded at Spring City has been awarded to Walker & Kepler, Philadelphia, Pa.

STATE COLLEGE, PA.—The State Centre El. Co., State College, will erect a new 6600-volt transmission line, 30 miles long, in the spring; also a 12-mile, 22,000-volt transmission line. H. J. Thompson is manager.

HARPERS FERRY, W. VA.—Extensions and improvements are considered by the Harpers Ferry El. Lt. & Pwr. Co., it is reported, involving an expenditure of about $17,000, to include the erection of a third transmission line between Harpers Ferry and Brunswick, Md., and the installation of a generator in power plant, a new wheel and meters for all consumers. The company, it is said, is also contemplating an extension of its system to Burkittsville, Md., along the State road to provide electrical service to farmers in that section.

MARTINSBURG, W. VA.—The Potomac Lt. & Pwr. Co., successor to the Martinsburg Pwr. Co., is considering the erection of an electric plant at Dam No. 5. The company also proposes to enlarge and improve its plants at Dams Nos. 4 and 5, at a cost of about $100,000.

SHEPHERDSTOWN, W. VA.—The Shepherdstown El. Lt. & Pwr. Co., it is reported, has engaged A. L. Alder, Brunswick, Md., to take charge of the engineering work in connection with construction of a hydroelectric plant and repairs to dam. Cost of the work is estimated at $15,000.

CREWE, VA.—The Norfolk & Western R. R. Co., it is reported, is increasing the output of its power plant in Crewe for the purpose of supplying electricity for operating and lighting the signals on the line between Phoebe and Norfolk, as well as for lighting all the stations and station premises. The capacity of the plant is to be doubled and transmission lines are to be erected along the Forest-Concord Belt Line from Phoebe west, to furnish energy for the signals on the belt line around Lynchburg.

WASHINGTON, D. C.—Bids will be received at the office of the Board of Award, Department of Agriculture, Washington, D. C., until Jan. 18 for furnishing one voltmeter and one milliwatt meter.

WASHINGTON, D. C.—The contract for engineering and construction work for the proposed extension of the Bennings steam-power plant of the Potomac El. Pwr. Co., Washington, has been awarded to the J. G. White Engineering Corpn., 43 Exchange Place, New York, N. Y. An extension will be built to the power house and an additional 15,000-kw. generator installed.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 25 for installation complete of an electric passenger elevator in the United States post office and court house at McCook, Neb., and for an electric passenger elevator and hydraulic freight lift, pumping plant, etc., in the United States post office and court house at Lawton, Okla., in accordance with specifications, copies of which may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., as follows: Washington, D. C., Schedule 9192—1900 ft. single-conductor cable. Boston, Mass., Schedule 9193—six exhaust fans. Brooklyn, N. Y., Schedule 9187—miscellaneous insulating material; Schedule 9193—seven motors and controllers and spares; Schedule 9196—1000 ft. leaded and armored wire; Schedule 9184—20,000 ft. plain twin-conductor wire. Applications for proposals should designate the schedule desired by number.

North Central

DETROIT, MICH.—Contracts have been awarded by the Detroit Edison Co., it is reported, for an addition to its power plant at 24 Willis Avenue West, to cost $50,000.

MONROE, MICH.—At a special election to be held Jan. 24 the proposal to issue $75,000 in bonds for a new municipal electric-light plant will be submitted to the voters.

CANNELVILLE, OHIO.—The power house of the Rise Hill Mining Co. in Cannelville was destroyed by fire on Dec. 29, causing a loss of about $15,000.

CHRISTIANSBURG, OHIO.—The Christiansburg Lt., Ht. & Pwr. Co., recently incorporated with a capital stock of $5,000, proposes to supply electricity for lamps, heaters and motors in Christiansburg and vicinity. Fred Green and others are interested.

CINCINNATI, OHIO. — The Business Men's Club of Cincinnati, it is reported, has decided to construct a new building, to cost about $600,000. The installation of a light and power plant in connection with the building is under consideration.

DAYTON, OHIO.—The Dayton Pwr. & Lt. Co., it is reported, has decided to erect a large central station, to cost about $1,000,000. The proposed plant will be situated at Miller's Ford, south of the city. The power station will be 182 ft. by 280 ft. and will have a generating capacity of 165,000 hp., about five times the capacity of the two power plants now operated by the company. Frank M. Tait is president of the company.

DRESDEN, OHIO.—Preparations are being made by the Dresden El. Lt. Co., recently incorporated with a capital stock of $10,000, to install electric equipment in its plant in Dresden. Maxwell Frazier and others are interested.

NEWCOMERSTOWN, OHIO.—The Village Council is considering municipal ownership of electric-light and water-works plants.

NEW CONCORD, OHIO.—The municipal electric-light plant has been purchased by the Ohio Ser. Co., Cambridge. The company will be granted a 25-year franchise and a ten-year contract for lighting the village. A transmission line will be erected by the company from Cambridge to New Concord to supply the service.

NORWOOD, OHIO.—The City Council has authorized bonds to be sold to provide funds for the installation of an ornamental lighting system in the business district. H. J. Pierson is service director and manager of the municipal electric-light plant.

SALEM, OHIO.—The Salem Ltg. Co., recently organized with a capital stock of $15,000, it is reported, is planning to install an electric plant to supply electricity in this vicinity. H. T. Hartman and others are interested.

SPRINGFIELD, OHIO.—Plans are being prepared by the Springfield Lt., Ht. & Pwr. Co. to begin work on the installation of new equipment to increase the output from 600 hp. to 1300 hp. about March 1.

ZANESVILLE, OHIO.—The Southeastern Ohio Ry. Co., Zanesville, has applied to the Public Utilities Commission for permission to issue $800,000 in capital stock, the proceeds to be used for the purchase of the electric line of the Southeastern Ohio Ry. & Lt. Co., running between Zanesville and Crooksville, and in extending the lines to New Lexington.

LOUISVILLE, KY.—Work will soon begin on the construction of a new branch exchange, to cost about $100,000, for the Louisville Home Tel. Co. in the eastern part of the city. The initial equipment will provide for 2500 wires with an ultimate capacity of 7500 lines.

WARSAW, IND.—The capital stock of the Commercial Tel. Co., Warsaw, has increased its capital stock from $100,000 to $200,000.

CHICAGO, ILL.—Bids will be received by the South Park Commissioners, Fifty-seventh Street and Cottage Grove Avenue, Chicago, until Jan. 19 for furnishing all incandescent lamps required for one year, beginning March 1, 1916. J. F. Neil is secretary.

CHICAGO, ILL.—Bids will be received by the First Cavalry, Illinois National Guard, Armory Commission, in the office of the state architect, 130 North Fifth Avenue, Chicago, until Jan. 24 for construction of the First Cavalry Armory Building. Separate bids to be submitted for general work; plumbing, drainage and standpipes; boiler plant, heating and ventilation; electric wiring; electric elevators, and hay, grain and ash elevators. Plans and specifications may be obtained at the office of J. B. Dibelka, state architect, upon deposit of $10. Col. Milton F. Forman is president of the First Cavalry Armory Commission.

MATTOON, ILL.—The Central Illinois Pub. Ser. Co., Mattoon, has applied for a certificate of convenience and necessity to erect and operate high-tension transmission lines between Sheldon Grove and Havana, and from Beardstown to Virginia, Ill.

ASHLAND, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 31, for a conduit and wiring system, lighting fixtures, etc., in the United States post office at Ashland. For details see proposal columns.

BUTTERNUT, WIS.—The Village Board has granted E. M. Schultz, Butternut, a franchise to construct and operate an electric-light plant here.

GLENWOOD CITY, WIS.—The Glenwood & Downing Lt. & Pwr Co., Glenwood City, is contemplating the erection of a 6600-volt transmission line to Boyceville. During the coming year the street lamps, which are at present operated directly from pole transformers with commercial lighting service, will be put on a separate circuit. L. M. Libby is superintendent.

MILWAUKEE, WIS.—The City Council is considering a proposal to include an item for $750,000 in the 1916 budget for the purchase of the street-lighting system.

MILWAUKEE, WIS.—Plans are being prepared for the construction of a steel finishing mill and power plant for the Fitzsimmons Steel & Iron Co., Chicago, Ill., to be erected at Eighth Avenue and Park Street.

SPOONER, WIS.—A permit has been granted to the city of Spooner by the State Railroad Commission to construct a power dam on Namekagon River. The plans provide for the development of 2000 hp. under a 25-ft. head. The cost is estimated at $40,000.

VIOLA, WIS.—The Viola Lt. & Pwr. Co. is considering the erection of a 2300-volt transmission line and the installation of an ornamental street-lighting system. H. R. Wagner is interested in the company.

FAIRMONT, MINN.—Bids will be received by A. Ward, Fairmont, until Jan. 25 for construction of a four-story, fireproof children's home and power house and barn. Plans and specifications may be obtained upon application to George Pass & Son, architects, Mankato, upon deposit of $15, of which $10 will be returned.

FLOODWOOD, MINN. — Arrangements are being made by the Superior Box Co. to enlarge its factory and install an electric plant to light the mill. The company may apply for a franchise to supply electricity to light the village.

JACKSON, MINN.—Improvements to the municipal electric-lighting plant and the installation of an ornamental lighting system are under consideration by the Village Council and Commercial Club.

MARIETTA, MINN.—The Interstate El. Lt. & Pwr. Co., Marietta, is planning to install an electric-lighting plant in Marietta to supply electricity in Marietta and three other towns. The proposed plant will be driven by oil engines. Otto Schultz is interested in the company.

MONTEVIDEO, MINN.—The Minnesota Valley Pwr. Co., Montevideo, will install a 300-hp. water-tube boiler (160 lb. pressure) and erect about 10 miles of three-phase, three-wire transmission line in the spring. J. W. Campbell, Jr., is manager.

REDWOOD FALLS, MINN.—Bids will be received by H. M. Aune, secretary of the board of education, Redwood Falls, until Jan. 25 for alterations and additions to high school, separate bids to be submitted as follows: (a) general construction; (b) plumbing contract; (c) heating contract; (d) electrical contract. Plans and specifications may be obtained upon application to Tyrie & Chapman, architects, Auditorium Building, Minneapolis, upon deposit of $15 for general contract and $10 for each of the other contracts.

ROCHESTER, MINN.—The St. Paul Southern El. Ry. Co., it is reported, contemplates the construction of an electric railway from Hastings to Rochester, a distance of 64 miles, during 1916. K. A. Schaller, Hastings, is superintendent.

THIEF RIVER FALLS, MINN.—Plans are being considered by the Minnesota-Northwestern El. Ry. Co., Thief River Falls, for the construction of about 20 miles of new line during 1916.

WACONIA, MINN.—The Waconia Lt. & Pwr. Co. has been granted a franchise to supply electricity for lamps and motors in the village of Cologne, and will erect a transmission line to that village soon. The company will be in the market for material for transmission-line and street-lighting system. E. F. Strong is president.

DOWS, IOWA.—The property of the Dows El. Lt. & Pwr. Co. has been purchased by the Iowa Falls El. Co., Iowa Falls. The local plant will be closed down and electricity supplied by the high-tension transmission line of the company now being erected to Belmond, which will supply energy to Dows, Popejoy, Rowan, Belmond, Alexander, Coulter and other places. The company is now asking a new franchise here.

LOCKRIDGE, IOWA.—At an election held recently the proposal to grant a franchise to R. M. Burtis and associates to supply electricity in Lockridge was carried. Energy to operate the system will be obtained from the Interstate Pwr. Co. at Oakland Mills.

McCALLSBURG, IOWA. — The City Council has decided to submit to the voters the proposal to grant a franchise to the Iowa Ry. & Lt. Co., Cedar Rapids, to erect an electric distribution system in McCallsburg.

CAMDEN, MO.—Application has been made to the Public Service Commission by the Missouri Gas & El. Co., Lexington, for permission to install and operate an electric-light plant in Camden. The company has been granted a municipal franchise.

GALLATIN, MO.—The city of Gallatin is installing a new municipal electric plant, which will be completed about next April. J. J. A. Carter is superintendent.

HOLTON, MO.—At an election held recently bonds to the amount of $7,000 were voted, it is reported, for a municipal electric plant.

KANSAS CITY, MO.—Plans are being prepared by the Ford Motor Co., Detroit, Mich., it is reported, for the construction of a power, lighting and heating plant at Twelfth and Winchester Streets. C. C. Mead is local manager.

RYDER, N. D.—A franchise for the installation of an electric-lighting plant in Ryder has been granted to E. E. Fredeen.

MARION, S. D.—The Council has granted a 20-year franchise to John Heib to install and operate an electric-light plant in Marion.

WOONSOCKET, S. D.—The Schuler El. Co., Woonsocket, is now installing a 150-hp. engine, one 150-hp. boiler, one 100-kw. and one 50-kw. alternating-current generator, and erecting transmission lines to the towns of Forestburg, Artesian and Lane. Energy will be transmitted at 6600 volts. The company will install a 50-kva. synchronous motor to drive the direct-current generator. A. G. Schuler is president and manager.

DESHLER, NEB.—The Deshler Lt. & Pwr. Co. will install a complete new steam plant early in the spring. J. H. Bokenkamp is manager.

ELKHART, KAN.—Application has been made to the Council by General Woods for a franchise to install and operate an electric-light plant in Elkhart.

LINWOOD, KAN.—Arrangements are being made for the installation of an electric-lighting system in Linwood. Negotiations are under way between the City Council and the Heim Interurban Co. to furnish energy to maintain it.

Southern States

ORANGEBURG, S. C.—Bonds to the amount of $30,000 have been sold, the proceeds to be used for the construction of a new power station. James E. Salley is superintendent.

GRAYMONT, GA.—The contract for construction of an electric-light plant to supply electricity in Graymont and Summit has been awarded to the Singleton-Smith Co., Macon. The cost is estimated at about $10,000.

CLEARWATER, FLA. — Surveys are being made for an electric railway to be constructed from Tampa to Clearwater on the west coast, a distance of 30 miles. E. W. Parker, Curry Building, Clearwater, is interested.

DANDRIDGE, TENN.—The local electric-light plant has been purchased by John A. Walker. Plans, it is understood, are being considered to operate the electric plant by water-power from the Walker mill and establish a day service.

HENDERSON, TENN.—The property of the Priestley-Lloyd Lt. & Pwr. Co., Henderson, has been purchased by the city of Henderson. Contracts have been awarded by the city for the installation of a water-works system in connection with the electric plant. Size and type of pumps not yet

definitely decided upon. P. R. Priestley is engineer of power station of municipal plant.

HUMBOLDT, TENN.—The city of Humboldt is considering extending the transmission lines of the municipal electric-light system to small towns within a distance of 12 miles. W. M. Case is secretary and manager.

DECATUR, ALA.—The installation of a municipal electric-light plant (to cost about $40,000) in under consideration by the Mayor and the Board of Aldermen.

RUSSELLVILLE, ALA. — Plans are being considered, it is reported, by the Sloss-Sheffield Steel & Iron Co., Birmingham, for the construction of a power plant, to cost about $50,000.

BATESVILLE, ARK.—The Board of Water and Light Commissioners is planning to install an ornamental lighting system (iron posts) on four blocks, to be maintained by underground wires. W. H. Walkup is superintendent.

BOONEVILLE, ARK.—The Booneville Lt. & Pwr. Co. contemplates the erection of a 16,500-volt, single-phase (cedar-pole) transmission line, 28 miles long, to supply four towns with electricity. Equipment will be required for street-lighting and distributing systems, meters, etc.; also material for a 4-mile, 2300-volt line, same as above, for one town only. The company is considering three installations, using single-phase motors from 5 hp. to 25 hp.; unity-power-factor motors desired. H. P. Hadley is manager.

GRAVETTE, ARK.—Improvements are contemplated to the municipal electric-light plant, including the installation of boilers, engines, generators and pumps. Will also purchase some heating and cooking apparatus. E. H. Crayton is superintendent.

PARAGOULD, ARK.—The City Council has passed an ordinance extending the franchise of the Arkansas Lt. & Pwr. Co. in Paragould to 50 years. The present franchise was granted in 1908 for 20 years. In consideration of the extension of the franchise the company has agreed to remodel its plant, installing a turbine engine and condenser, and to install an ornamental street-lighting system, consisting of 64 standards carrying five-lamp clusters, and also to make a reduction in the lighting and power rates.

NEW ORLEANS, LA.—The Federal Fruit & Cold-Storage Co., New Orleans, is contemplating the construction of an ice and cold-storage plant. The plans provide for a compound condensing plant, electrically operated loading and unloading devices, elevators and conveyors. The cost is estimated at $250,000. Plans are also being considered by the company for a system of cold-storage plants at Macon, Ga., and other cities where the company operates.

DURANT, OKLA.—The Durant Ice & Lt. Co. will erect a high-tension transmission line to Caddo and connect the plant there with the Durant plant in the spring. W. J. O'Brien is secretary and manager.

SHAMROCK, OKLA—The Oil Fields Gas, El. & Pwr. Co., recently organized, it is reported, will erect a transmission line (20 miles long) connecting Shamrock, Dumright and Depew. S. W. Barnes, Orear-Leslie Building, Kansas City, Mo., has charge of the construction of the proposed plant.

SPIRO, OKLA.—The installation of a natural-gas system has just been completed by the light and water commission. The purchase of a gas-engine unit this summer for the electric plant is under consideration. H. R. Walder is superintendent.

BRYAN, TEX.—The installation of an ornamental lighting system, consisting of 54 standards, on Main Street is reported to be under consideration by the City Council.

CORSICANA, TEX.—The Corsicana Cotton Mill Co. is planning to erect a factory building (100 ft. by 140 ft., two stories high), increasing capacity from 8000 to 10,000 spindles, and will also add 100 looms. It is proposed to install gas engines (500 hp.), costing $17,500. The company is also estimating on electrical power.

NOCOMA, TEX.—The Nocoma Ice & Lt. Co. is planning some line extensions in the city and will install another oil engine in the fall. J. W. Lehman is president and manager.

SHERMAN, TEX.—The Municipal Water and Light Department will replace all arc lamps with tungsten lamps (making a total of 700 lamps of 100 cp.) within the next two months. S. C. Gates is superintendent of electric-light plant.

TROUP, TEX.—The Troup Lt. & Pwr. Co. will install a 50-hp. oil engine and a 40-kw. generator in March. J. D. Nance is owner and manager.

Pacific States

KELSO, WASH.—The North Coast Pwr. Co., Vancouver, it is reported, will soon begin work on the erection of an electric transmission line to furnish electricity to diking district No. 1, situated in Kelso. Other extensions are also contemplated by the company.

JOSEPH, ORE.—The Joseph Lt. & Pwr. Co. expects to erect 5 or 6 miles of transmission line next spring.

SALEM, ORE.—F. A. Legg, architect, Salem, has been engaged to prepare plans for the installation of a switchboard and lighting system in the Odd Fellows' Opera House Building. Bids for installation, it is reported, will soon be asked for.

BANNING, CAL.—The Lt. & Pwr. Utility Co., Banning, contemplates making a few extensions and installing a street-lighting system this spring. C. H. L. Ghriest is manager.

EUREKA, CAL.—The Western States Gas & El. Co., Eureka, is installing 1200-hp. Stirling boilers. H. L. Jackman is manager.

LOS ANGELES, CAL.—The Pacific Lt. & Pwr. Corpn., Los Angeles, contemplates an expenditure of between $1,500,000 and $2,000,000 for extensions, additional substation equipment, etc., during the year 1916. Definite plans have not as yet been worked out. E. R. Davis is general manager.

REDDING, CAL.—The City Trustees have rejected all bids submitted for the erection of the first unit of the municipal lighting system, on the ground that the bids were too high. The work will now be done under the supervision of the board.

SAN DIEGO, CAL.—The San Diego Consol. Gas. & El. Co. contemplates the construction of a new garage, the extension of rock jetties at condenser intake, and installation of underground cables on Fifth Street from H to K Street. During the year the company contemplates purchasing the usual quantity of transformers, meters, wire and cables, poles, cross-arms and miscellaneous line hardware for ordinary commercial extensions. L. M. Klauber is superintendent of electrical department.

SAN FRANCISCO, CAL.—The Fleishhackers and interests associated with them, it is reported, are organizing a company to be known as the Western Electro-Chemical Co., which will be capitalized at $2,500,000. The company will manufacture by an electrical process caustic soda, bleaching powder and other chemicals.

SAN FRANCISCO, CAL.—The State Railroad Commission has authorized the Great Western Pwr. Co., San Francisco, to issue $5,000,000 in debentures, the proceeds to be used as follows: (a) $3,000,000 for the acquisition of the stock of the City El. Co., San Francisco, on the condition that the City El. Co. invests the $3,000,000 in additions and extensions to the properties belonging to it and the Great Western Pwr. Co.; (b) $1,500,000 for the erection of a second transmission line from the hydroelectric development at Big Bend, Butte County, to Oakland; (c) $250,000 for the construction of two cable lines across San Francisco Bay from Alameda County to San Francisco.

PEACH SPRINGS, ARIZ. — Arrangements are being made for the construction of the first of the series of power plants which it is proposed to build west of Grand Canyon. The site of the first dam will be just east of the Diamond Creek Canyon. The present plans provide for a development of 50,000 hp., which later will be doubled. It is expected to have the first unit in operation within eighteen months. James G. Girand of Phoenix is engineer in charge.

GREAT FALLS, MONT.—The Montana Pwr. Co., Great Falls, has announced its intention of erecting transmission lines to supply electricity for lamps and motors in the Sun River Valley. Work, it is understood, will start early in the spring.

MALTA, MONT.—The Malta Lt. Co. will soon install a 35-hp. gas-producer engine and a 75-hp. gas producer, changing 60-hp. kerosene engine for gas producer. C. H. McCreary is manager.

DEL NORTE, COL.—The town of Del Norte may possibly extend the transmission lines of the municipal electric-lighting system about 5 miles during this year to supply electricity to farmers. George A. Bankert is chief engineer and electrician.

DURANDO, COL.—Arrangements are being made by the Western Colorado Pwr. Co., Montrose, to equip a steam-driven electric plant in Durango, to be used as an auxiliary to the hydroelectric plant at Rockwood.

FORT MORGAN, COL.—The city of Fort Morgan is contemplating the installation of a coal conveyor from the railroad track to its coal bin, a distance of 135 ft. George G. Cox is general superintendent.

LITTLETON, COL.—The Arapahoe El. Lt. & Pwr. Co. is now installing a new street-lighting system in Englewood and Sheridan, using 6.6-amp. nitrogen lamps ranging from 60 cp. to 250 cp. The company is also contemplating the installation of a substation (high-tension) with modern equpment. O. F. Nats is superintendent.

STERLING, COL.—The control of the Sterling Consolidated El. Co. is reported to have passed into the hands of J. Foster Symes and L. P. Hammond of Denver and H. L. Titus of Sterling. The new owners, it is understood, contemplate extending the transmission lines to cover a large territory in northeastern Colorado.

VICTOR, COL.—The Arkansas Valley Ry., Lt. & Pwr. Co., Victor, is contemplating a general overhauling of its lines. W. T. Clark is superintendent of the mountain division.

Canada

MEDICINE HAT, ALTA.—Plans are being considered by the Lake of Woods Milling Co., Medicine Hat, for the installation of heavier power-plant machinery.

MERRICKVILLE, ONT. — The by-law providing for lighting the street by electricity has been approved by the ratepayers.

NIAGARA FALLS, ONT.—Plans are being considered by the City Council for the installation of ornamental lamps along the River Road similar to those in the business district.

SARNIA, ONT.—The by-law authorizing an appropriation of $120,000 for the purchase of the electric generating plant and distributing system of the Sarnia Gas & El. Co. and for remodeling same was approved by the ratepayers on Jan. 3. The ratepayers also voted in favor of the by-law providing for securing energy from the Hydro-Electric Power Commission of Ontario.

TORONTO, ONT.—The ratepayers in several towns in the Province of Ontario, including Baden, Forest, Cobden, Komoka, Parkhill and Tara, have approved by-laws authorizing contracts with the Ontario Hydro-Electric Power Commission for electricity.

WINDSOR, ONT.—The City Council, it is reported, is contemplating extensions and improvements to the hydroelectric system, involving an expenditure of about $70,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Jan. 29 for a refrigerating apparatus, electric cable, cable end bells, barbed wire, staple-steel locomotive pilots, tank wells, copper gaskets, etc. Blanks and general information pertaining to the circular (No. 1004) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 23, for bronze castings, malleable-iron castings, steel castings, steel forgings, machinery-steel bars, steel plates and shapes, steel springs, lock washers, electric cable and wire. Blanks and general information relating to this circular (No. 1005) may be obtained from the above office or from the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 64 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

MANILA, P. I.—Bids will be received by the Central Sugar Board, Manila, until April 15 for constructing and equipping, complete, sugar plantation in the district of Isabel-Binabagan. The work to include factory to work up 1000 tons of cane per day, adequate mechanical apparatus for discharging cane from cars and wagons and distributing on cane carrier, cane carrier, crusher and four sets of three-roll mills, engines, hand-power traveling crane, clarification plant, concentration plant, pumps, crystallizers, mixers, tanks, piping, valves, electric power plant, water supply, including electrically operated pumping plant and steel-pipe line, factory building, workshops, tools and repair appliances, chemical laboratory, sugar house, 36-in.-gage railway, rolling stock, track scales, etc. The project is financed by the government of the Philippine Islands. Specifications may be obtained from the Bureau of Insular Affairs, War Department, Washington, D. C.

1,166,426. ELECTRICAL TESTING STANDARD; C. B. and J. M. Beck, Philadelphia, Pa. App. filed Feb. 8, 1912. Immersed coil resistance standard.

1,166,432. CONDUIT FOR ELECTRIC WIRES; R. S. Case, Unionville, Conn. App. filed Aug. 4, 1911. Made of special plies of paper.

1,166,441. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed March 27, 1911. Automatic regulator which can be cut in or cut out.

1,166,442. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed June 21, 1911. Governs generator in accordance with duty performed thereby.

1,166,443. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Sept. 29, 1911. Particularly for battery charging.

1,166,464. METHOD OF MAINTAINING THE EFFICIENCY OF METALLIC - FILAMENT LAMPS; A. J. Liebmann, New York, N. Y. App. filed Oct. 25, 1913. Evaporates catalytic substance within lamp by heat of filament.

1,166,466. AUTOMATIC TELEPHONE SYSTEM; A. E. Lundell, New York, N. Y. App. filed March 19, 1915. Always has a plurality of connecting currents pre-selected or allotted.

1,166,582. WIRELESS APPARATUS FOR PRODUCING AND TRANSMITTING MUSICAL SOUNDS; George Desilets, Nicolet, Quebec, Canada. App. filed June 29, 1914. Plurality of musical sending keys.

1,166,605. AUTOMATIC ELECTRIC-WINDING CLOCK; U. S. Kreider, Arcanum, Ohio. App. filed Sept. 1, 1914. Clock spring controls electric rewinding.

1,166,617. HOLDER FOR TROLLEY POLES; H. E. Mattox, Sherman, Cal. App. filed March 24, 1914. Firmly holds pole lowered.

1,166,620. TELEPHONE-CALLING MECHANISM AND SYSTEM; J. H. Melvin, Columbus, Ohio. App. filed Jan. 20, 1909. Switches have vertical and rotary motion.

1,166,624. ALARM DEVICE FOR VALVES; J. D. Nelson, Cincinnati, Ohio. App. filed Feb. 9, 1911. Time-service distribution system.

1,166,637. COLLECTOR FOR ELECTRIC TRACTION; R. C. Sayer, Redland, near Bristol, England. App. filed July 12, 1912. Enables passing of cars on parallel tracks, drawing current from single wire.

1,166,645. LOCK-OUT PARTY-LINE TELEPHONE SYSTEM; B. D. Willis, Chicago, Ill. App. filed Feb. 29, 1912. Particularly for automatic or semi-automatic systems.

1,166,648. ELECTRIC WELDING MACHINE; C. M. Agnew, Milwaukee, Wis. App. filed May 4, 1914. For "butt-welding."

1,166,650. AUTOMATIC CIRCUIT-BREAKER; C. C. Badeau, Winthrop, Mass. App. filed Feb. 17, 1911. Wide break secured by inclined mounting of breaker

1,166,682. ELECTROMAGNETIC SEPARATOR; C. T. Henderson, Milwaukee, Wis. App. filed March 5, 1915. Magnetic pulley construction.

1,166,693. CAR TRUCK; W. F. Kiesel, Jr., Altoona, Pa. App. filed July 2, 1914. Pedestal, brake hanger and transom construction.

1,166,696. LOCOMOTIVE; W. F. Kiesel, Jr., Altoona, Pa. App. filed Aug. 20, 1914. Electric; special mounting of jack-shaft crank.

1,166,699. ALTERNATING-CURRENT MAGNET; W. D. Lutz, Allendale, N. J. App. filed March 20, 1912. Particularly for elevator brakes.

1,166,706. ELECTROMAGNET; T. W. Morgan, Waterloo, Iowa. App. filed April 19, 1915. Quick demagnetizing for ignition work.

1,166,725. BRAKE; A. R. Trezise, Sr., Brooklyn, N. Y. App. filed Dec. 24, 1913. Brake levers capable of rotary movement for "easing off" brakeshoes.

1,166,752. BALL JOINT FOR LAMP SUPPORTS AND THE LIKE; T. D. Finizio, New York, N. Y. App. filed May 10, 1915. Permits the lamp being set and held in any position.

1,166,753. BRACKET FOR ELECTRIC LAMPS AND THE LIKE; T. D. Finizio, New York, N. Y. App. filed May 10, 1915. Self-winding reel for the cord.

1,166,765. APPARATUS FOR INDICATING AT A DISTANCE THE SPEEDS OF SHAFTS OR THE LIKE; Paul Kaminski, Spandau, Germany. App. filed Jan. 13, 1912. Embodies a system of magnets.

1,166,792. EVACUATION PROCESS; H. C. Snook, Cynwyd, Pa. App. filed Oct. 8, 1912. Shortens length of time required for evacuating lamp bulbs.

Record of Electrical Patents

Notes on United States Patents issued Jan. 4, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,166,797. PHOTOGRAPHIC PLATE HOLDER FOR USE WITH X-RAYS; G. H. White, Haverford, Pa. App. filed June 21, 1913. Accommodates one or a number of plates.

1,166,826. RAIL-JOINT BOND; H. Etheridge, Zelienople, Pa. App. filed March 24, 1914. Hooks into incasement with foot of rail.

1,166,852. PHONOGRAPH SYSTEM FOR REVOLVING AUDITORIUMS; L. E. Myers, Chicago, Ill. App. filed June 12, 1915. Designed for the San Francisco Exposition in connection with the Panama Canal exhibit.

1,166,871. DRY BATTERY CELL; Henry Wilhelm and Harold Olaneta, Brooklyn, N. Y. App. filed Nov. 3, 1914. Porous material wrapped about cartridge and then pressed into cell.

1,166,892. APPARATUS FOR PRODUCING HIGH-FREQUENCY OSCILLATIONS; R. A. Fessenden, Brant Rock, Mass. App. filed March 22, 1905. Decharged gap construction.

1,166,893. METHOD FOR PRODUCING HIGH-FREQUENCY OSCILLATIONS; R. A. Fessenden, Brant Rock, Mass. App. filed March 22, 1905. Continuous or practically so.

1,166,898. FROG FOR TROLLEY WIRES; C. E. Gierding, Mansfield, Ohio. App. filed Feb. 26, 1912. Made of simple metal casting.

1,166,912. TROLLEY-WIRE APPARATUS; W. H. Kempton, Mansfield, Ohio. App. filed April 8, 1912. Castings requiring no machining.

1,166,915. RAILWAY SIGNALING; C. H. Lay, Wilkinsburg, Pa. App. filed Nov. 21, 1914. Controlled by track circuits.

1,166,919. ELECTRIC - TRACTION - CONTROL SYSTEM; S. D. McCaleb, Louisville. App. filed July 29, 1912. For single-track roads.

1,166,923. COMMUTATOR BRUSH; G. S. Neeley, St. Louis, Mo. App. filed Jan. 21, 1915. Flexible conductor from pivot of roller-carrying arm to roller.

1,166,928. INSULATOR-SUPPORTING BRACKET; C. L. Peirce, Jr., Pittsburgh, Pa. App. fied May 4, 1914. For high-tension distribution service.

1,166,930. TELESCOPIC COMBINED PORTABLE FLASHLIGHT AND WRITING PAD; J. A. Petrie, Westville, Conn. App. filed July 6, 1915. Telescoping shell with writing material, applied over flashlamp.

1,166,950. ELECTRICAL HOT-WATER APPARATUS; Johann von Hentzel, New York, N. Y. App. filed Dec. 16, 1914. Water flowing between electrodes serves as resistance.

1,166,951. RESONATING RELAY; Hans von Kramer and Gisbert Kapp, Birmingham, England. App. filed June 4, 1913. Improved arrangement of flanking contact member for reed.

1,166,974. MACHINE-TOOL CONTROL; A. L. De Leeuw, Plainfield, N. J. App. filed Feb. 19, 1913. Particularly designed for milling machines and the like.

1,167,020. MAGNETIC DISPLAY DEVICE; W. G. Reuter, Cincinnati, Ohio. App. filed May 18, 1915. For moving an advertising object over a circuitous path.

1,167,026. ELECTRIC FURNACE; F. T. Snyder, Oak Park, Ill. App. filed Jan. 19, 1914. Permits electrode being adjusted vertically and swung to one side of furnace.

1,167,037. SOCKET SHELL; L. W. Anderson, Waterbury, Conn. App. filed Feb. 24, 1915. Screw connection for securing parts of shell together.

1,167,038. CIRCUIT - CONTROLLER SWITCH AND CASING THEREFOR; V. G. Apple, Dayton, Ohio. App. filed May 19, 1914. For automobile starting and lighting systems.

1,167,039. ELECTRIC-CONDUIT FITTING AND ELECTRIC APPLIANCE; C. H. Bissell, Syracuse, N. Y., and D. C. Gidley, Boston, Mass. App. filed Oct. 28, 1911. Socket resiliently held by clamp conduit coupling.

1,167,041. INSULATOR SUPPORT; R. C. Boozer, Chicago, Ill. App. filed June 8, 1914. Threaded sections spaced to allow for irregularities and molded insulator.

1,167,042. INSULATOR SUPPORT; R. C. Boozer, Chicago, Ill. App. filed July 11, 1914. Especially designed for high-tension wires.

1,167,045. ELECTRICAL OPERATING AND INDICATING MEANS; H. E. Cade, Pencoyd, and W. F. Cochrane, Philadelphia, Pa. App. filed June 17, 1914. Selenium-cell smoke indicator.

1,167,053. TELEPHONE SYSTEM; A. H. Dyson, Montclair, N. J. App. filed March 31, 1914. Automatic connecting switches.

1,167,067. ELECTROMAGNETIC DEVICE; R. N. Hill, New York, N. Y. App. filed Dec. 12, 1913. Constant air-gap between armature and pole pieces.

1,167,085. AUTOMATIC DOOR-RELEASING DEVICE; C. E. Lindig, New York, N. Y. App. filed Jan. 18, 1915. Door releaser operated each time call bell is rung.

1,167,095. ELECTRIC HEATER; J. B. Murray, Brooklyn, N. Y. App. filed June 28, 1915. Sheet-metal toaster.

1,167,115. SIGNAL FOR AUTOMOBILES; Henry Rose, Shreveport, La. App. filed Feb. 18, 1915. Extensible fanlike structure.

1,167,119. BUFFER MACHINE FOR ALTERNATING - CURRENT SYSTEMS; Arthur Scherbius, Baden, Switzerland. App. filed June 27, 1908. Returns energy at proper frequency.

1,167,125. METHOD OF MANUFACTURING STRAIN INSULATORS; Thomas Sloper, Devizes, England. App. filed March 31, 1915. Built-up construction in which all threads take share of load.

1,167,132. ATTACHMENT FOR CALCULATING MACHINES; Martin Teetor, Des Moines, Iowa. App. filed March 3, 1911. Motor controlled by treadle.

1,167,138. BLOCK-SYSTEM SWITCHBOARD; R. L. Turk, Minneapolis, Minn. App. filed March 21, 1912. Eliminates need of removable plugs.

1,167,157. MAXIMUM INDICATOR; C. G. Durfee, Rochester, N. Y. App. filed July 20, 1912. Alternating-current motor determines the intervals of time.

1,167,163. COHERER; C. F. Frank, Schenectady, N. Y. App. filed June 10, 1914. Thorough decoherence.

1,167,176. SMELTING OF ORES AND APPARATUS THEREFOR; F. W. Highfield, Caversham, England. App. filed Feb. 23, 1915. Reduction of complex sulphide ores.

1,167,185. TELEPHONE PROTECTOR; O. W. Kurth, Berlin, N. D. App. filed March 26, 1915. Lightning arrester with cleaner.

1,167,208. INSULATOR; W. Oppelt, Metuchen, N. J. App. filed Feb. 8, 1915. Eliminates need for tie wires.

1,167,232. ATTACHMENT PLUG; S. Trood, Pittsburgh, Pa. App. filed Oct. 26, 1912. Swiveling construction.

1,167,247. SYSTEM AND APPARATUS OF AUTOMATIC ELEVATION AND LATERAL DIRECTION OF ONE OR MORE GUNS; F. Andersen, Haaögen, near Tonsberg, Norway. App. filed April 29, 1912. Embodies synchronously running motors.

1,167,294. RAILWAY BLOCK SIGNALING SYSTEM; W. Grunow, Jr., New York, N. Y. App. filed Jan. 16, 1915. Signal automatically set as car enters and leaves blocks.

1,167,310. INTERRUPTER MECHANISM FOR IGNITION DYNAMOS; C. T. Mason, Sumter, S. C. App. filed Nov. 21, 1912. Improved interrupter and condenser structure.

1,167,318. MAGNETIC LATCH; F. A. Schoenle, Buffalo, N. Y. App. filed April 18, 1914. For elevator doors.

1,167,325. COMBINED CENTRAL ENERGY TELEPHONE AND WATCHMAN'S CLOCK SYSTEM; L. Airhart, West Reading, Pa. App. filed Dec. 4, 1913. Raising receiver records the station and time.

1,167,344. AUTOMATIC ORGAN; M. C. Beman and F. A. Pilcher, Binghamton, N. Y. App. filed April 16, 1913. Represents thirty different musical instruments. (Forty claims.)

1,167,366. DYNAMO-ELECTRIC MACHINERY; R. A. Fessenden, Brookline, Mass. App. filed Jan. 29, 1913. Submarine signaling.

1,167,368. HEAD SUPPORT FOR TELEPHONE RECEIVERS; C. Adams-Randall, Boston, Mass. App. filed March 24, 1914. Vertical and swivel adjustment of receivers.

1,167,370. RAIL BOND; J. Lindley, Providence, R. I. App. filed April 14, 1914. Completely concealed by fishplates.

14,041 (reissue). REAR-END SIGNAL FOR VEHICLES; C. F. Marston, Cedarhurst, N. Y. Original No. 1,095,902, dated May 5, 1914; reissue filed Aug. 18, 1915. Controlled by foot pedal.